

PUBLIC HEALTH REPORTS

VOL. 39

FEBRUARY 1, 1924

No. 5

VISCOSITY AND TOXICITY OF ARSPHENAMINE SOLUTIONS.

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The occurrence of acute reactions, the so-called nitritoid crisis, sometimes following the intravenous injection of arsphenamine, has led pharmacologists to search for experimental evidence which might serve to explain the cause of these reactions and the mechanism by means of which they are produced.

At first it was thought that chemical impurities of the drug were largely to be held responsible. While this may be so in the case of products of careless manufacture, the view has gradually gained ground that variation of the physicochemical properties of the drug may exert a decided influence on the toxic action. Danysz (1917) believes that many of the reactions are due to precipitation of the drug in the circulating blood by certain blood constituents, the nature of which is not disclosed. The Salvarsan Committee of the British Medical Research Council (1919) expresses the opinion that variations in toxicity of different lots is probably related to small differences in the physical properties. Roth (1920) states that under well-controlled conditions, the toxicity of a 1 per cent solution of arsphenamine hydrochloride is four times greater than that of a 2 per cent alkaline solution of the same preparation containing the same impurities. Hunt (1921) finds that some preparations of arsphenamine are very toxic when the solutions are prepared at ordinary room temperature, and that the toxicity is greatly reduced by moderate heating or by allowing the solutions to stand for a time at room temperature. He suggests that these changes in toxicity may be due to a simultaneous change in the physical state of the solution. The same observation was made independently by G. C. Lake (unpublished observation). Karsner and Hanzlik (1920) and Oliver (1922) have found that arsphenamine causes intravascular agglutination of red blood corpuscles, resulting in the production of emboli. Jackson and Smith (1918) and Smith (1920) had previously observed that the pulmonary blood pressure in dogs shows a tremendous rise after a rapid arsphenamine injection, and

they also suggest that this disturbance of the circulation may be due to mechanical factors. Recently, Oliver (1922) made the interesting observation that the injection of an arsphenamine solution to which gelatine had been added as a protective colloid markedly reduces the toxicity. He makes a distinction between the immediate or physical toxicity and the late or chemical toxicity. The latter had been previously explained by Voegtlin and Smith (1920) as being due to the partial oxidation by the animal tissues of the arsphenamine molecule to the corresponding trivalent arsenious oxide, which is highly toxic to the animal and the parasites.

In a paper read before the American Society for Pharmacology and Experimental Therapeutics in December, 1922 (see Proceedings), we reported observations which furnish further convincing proof for the theory that, besides the chemical toxicity of arsphenamine, there is also a physicochemical factor which determines the toxicity of the drug. We have succeeded in correlating in a quantitative manner a physical property of arsphenamine solution, i. e., viscosity, with toxicity. For a number of years we had thought that there must be a physical factor which determines the toxicity of arsphenamine. How otherwise could be explained the very much higher toxicity of the hydrochloride over that of the sodium salt, and the very great influence of the rate of injection upon toxicity; and, furthermore, the complete agreement between these observations in animals and clinical experience? (Clinicians have warned against the use of solutions of the hydrochloride and against a fast rate of injection.)

Then, again, everyone who studies the behavior of arsphenamine is impressed by its colloidal nature. At the hydrogen ion concentration of the blood it is thrown out of solution as a voluminous gel; in other words, it behaves like an amphoteric colloid. It is therefore not surprising that arsphenamine should lead to severe disturbances in the colloidal equilibrium of the blood. Through a fortunate chance observation we were led to use the viscosity as a measure of the physicochemical properties of the drug. We had observed in testing a great variety of different arsphenamines that solutions of the same concentration showed a different degree of viscous appearance, and this seemed to be related to toxicity.

METHOD USED FOR DETERMINATION OF THE VISCOSITY OF ARSPHENAMINE SOLUTIONS.

The viscosity, or inner friction, of a liquid is most conveniently determined by means of the Ostwald viscosimeter, which consists of a glass bulb of known volume attached to a capillary tube, and a bulb or some other form of vessel at the other end of the capillary

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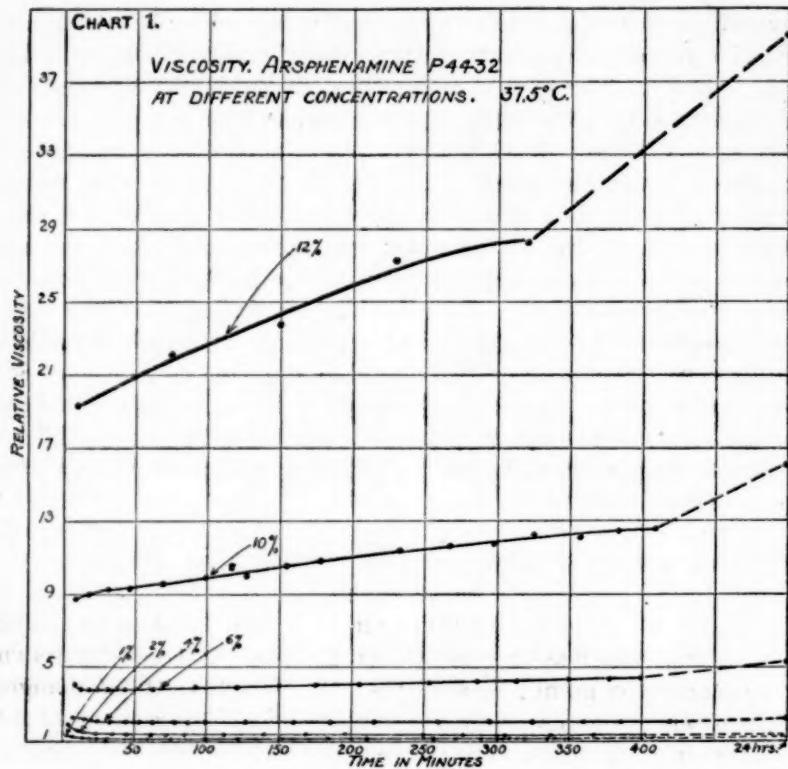
to receive the liquid. The time required for the liquid in the first bulb to flow through the capillary tube is determined and compared with the time required for the same volume of distilled water to flow through the same tube under the same pressure and at the same temperature. The relative viscosity expresses the viscosity of a given fluid in terms of the viscosity of water under constant conditions of pressure and temperature, the viscosity of water being taken as unity. The flow of water through the instrument used in this work was 189, 268, 304, and 484 seconds for temperatures of 37.5° , 21° , 15° , and 0° C., respectively, for ordinary barometric pressure. The figures given in this report have no absolute value, but are useful for comparative studies. In order to keep the temperature constant, the viscosimeter was immersed in a waterbath provided with a thermoregulator, so as to prevent variations in temperature greater than $\pm 0.1^{\circ}$ C. The regulation of temperature is of the greatest importance, and care should always be exercised to adjust the temperature of the liquid at the time when a viscosity estimation is made. Other requirements which must be fulfilled are that the instrument must be carefully cleansed with water, followed by alcohol and ether, and that the solution be absolutely free from undissolved material.

EFFECT OF CONCENTRATION ON THE VISCOSITY OF ARSPHENAMINE SOLUTIONS.

It was of interest to determine by preliminary experiments the viscosity of arsphenamine solutions of different concentrations. For this purpose a certain lot of arsphenamine was dissolved in distilled water of the same temperature so as to yield solutions ranging in concentration from 1 to 12 per cent. The results are given in Chart 1. It will be seen that the initial viscosity of freshly prepared solutions is a function of the concentration. Whereas a 1 per cent solution of this particular arsphenamine has a relative viscosity only slightly above that of water, a 12 per cent solution is almost 20 times as viscous. Different preparations of arsphenamine yield somewhat different figures. These observations are a confirmation of those made by Klemensiewicz, who was the first investigator to determine the viscosity of arsphenamine, without, however, studying the toxicity.

It is furthermore shown by Chart 1 that the viscosity may change considerably as a result of allowing the solutions to stand. The more dilute solutions (1 to 4 per cent in this particular case) become less viscous on standing, whereas the viscosity of the more concentrated solutions increases very considerably, and saturated solutions have a tendency to gel after standing for a day. It is difficult to

explain these viscosity changes on the basis of the available evidence. It is possible that changes in polymerization may be held responsible or, what is more likely, changes in degree of hydration. Either of these changes would lead to a change in the size of the particles,



and this would obviously result in a change in viscosity. At any rate, these observations clearly indicate that, while standing, a freshly prepared arsphenamine solution undergoes certain physico-chemical changes which find expression in a change of viscosity.

RELATION BETWEEN VISCOSITY AND TOXICITY OF ARSPHENAMINE (HYDROCHLORIDE).

It has been shown previously (Voegtlin and Smith) that aqueous solutions of arsphenamine (as the hydrochloride) are very resistant to the oxidative action of atmospheric oxygen. In fact, it was found that the reducing power of such solutions, determined by titration with a standard iodine solution, is not changed for many hours by running a current of air through the solution. Hence it should be possible to detect a relation between the viscosity and toxicity of such solutions without running any danger of the results

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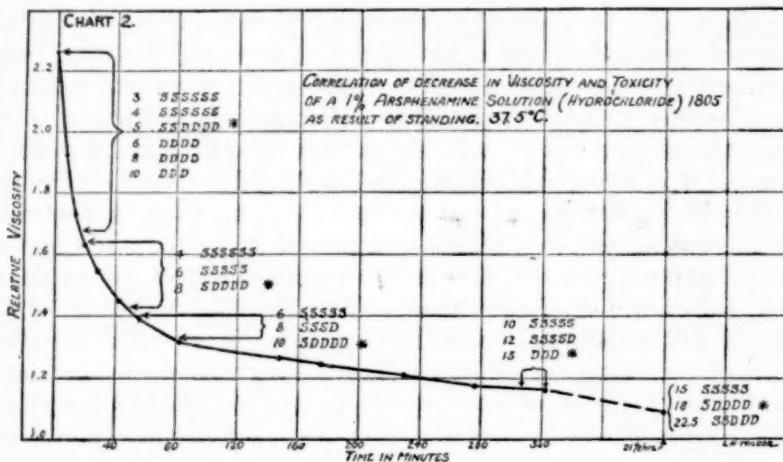
of such experiments being made unreliable on account of a chemical decomposition ("arsenoxide" formation) of the drug.

(a) *Effect of standing of solution on its viscosity and toxicity.*—As pointed out previously, dilute solutions of arsphenamine uniformly show a decrease of their viscosity on short standing. After a certain length of time (varying with the lot of arsphenamine under investigation) the viscosity then tends toward a constant value. Chart 2 illustrates this viscosity change. In this case a 1 per cent arsphenamine solution was made by rapidly dissolving the required amount of arsphenamine in distilled water of 37.5° C. in a tall glass cylinder immersed in a water bath of the same temperature, solution being facilitated by means of stirring with a glass rod. As soon as solution was completed, the viscosimeter, also immersed in the water bath, was filled with 5 c. c. of the solution and the viscosity was determined at once. The remaining solution in the cylinder was used for the toxicity determinations, part of the solution being taken as required and injected immediately into albino rats weighing from 100 to 150 grams. The rats were healthy, nonpregnant animals of our standard stock, fed on a diet of oats, bread, and milk until 18 hours before being used, when all food was withdrawn with the exception of water. The injections were made into the exposed leg vein at the standard rate of 0.5 c. c. per minute (no anesthetic used). The time at which each viscosity determination was made was carefully ascertained by noting the time at which the meniscus passed the upper and lower mark, respectively, of the viscosimeter, and then dividing this time in half. This time was then plotted on the chart and a curve drawn through successive points. As the viscosity of fresh solutions changes rapidly it was necessary to systematize the work in order to permit the injection of as many rats as possible with the smallest possible simultaneous change in viscosity.¹ The injection time was also obtained by taking the mean between the time of beginning and ending the injection. In this manner it was possible to tell how many animals survived or died when injected with a solution of a certain viscosity range. In Chart 2 and the subsequent charts and tables, S stands for survival of the animal for at least 24 hours and D for death within 24 hours after injection.² The figures attached to the viscosity curve indicate the dose of drug injected expressed in milligrams per kilo body weight. The dose (marked by an asterisk (*)) which killed the majority of the animals was always considered the minimum lethal dose.

¹ This was arranged by having one person make the solution and the viscosity determinations, a second and third person attend to the injections, and a fourth person note the symptoms and time of death of the animals. But even with this arrangement it was necessary to repeat the experiment a number of times with each lot of arsphenamine in order to get the toxic range for each range of viscosity.

² Inasmuch as the acute toxicity of the drug was under investigation, it appeared sufficient to observe the animals for only 24 hours.

Attention is first called to the remarkable regularity in the change in viscosity of the arsphenamine solution used in the work illustrated by Chart 2. The viscosity of the freshly made solution is more than twice (2.26) that of distilled water, and on standing for 16 minutes drops to 1.68. The M. L. D. (minimum lethal dose) for this viscosity range is 5 mg. per kilo. Between 20 and 25 minutes from the beginning of the experiment the relative viscosity gradually decreases from 1.63 to 1.42, and the M. L. D. for this range increases to 8 mg. per kilo.



The following viscosity range of 1.4 to 1.33 gives a M. L. D. of 10 mg. per kilo. Then, with a viscosity of 1.17, the M. L. D. is 15 mg. per kilo. After this the solution stood in the closed viscosimeter and cylinder over night at the same temperature. The following day, or 21½ hours after the beginning of the experiment, the viscosity had dropped to 1.08, and the M. L. D. had increased to 18 mg. per kilo. In other words, the gradual decrease in the viscosity of the solution during the 21½ hours of standing was accompanied by a decrease in toxicity of 72 per cent. We desire to call particular attention to the great regularity and accuracy of these changes in viscosity and toxicity and it may be stated that many repetitions of these experiments yielded exactly the same results.

Similar viscosity curves and toxicity changes were obtained with numerous other lots of arsphenamine secured from licensed manufacturers or prepared by us.

In view of the fact that concentrated solutions of arsphenamine exhibit (Chart 1) an increase in viscosity on standing, it would have been very interesting to determine whether this *increase in viscosity* is accompanied by an *increase of toxicity*, as should be expected. Unfortunately, this could not be done as the toxicity of more con-

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centrated solutions was of such an order that the small volume of solution representing a single fatal dose for the rat could not possibly be measured with any degree of accuracy by means of the smallest syringe or gravity burette available and work on larger animals was precluded on account of the large number of animals required for this kind of work.

(b) *Correlation of viscosity and toxicity of arsphenamine hydrochloride of different manufacture.*—The next problem was to determine whether or not it was feasible to correlate the toxicity of different lots of arsphenamine with their viscosity. The arrangement for this work was exactly the same as that described in the preceding chapter. One per cent solutions of the hydrochloride of the different lots were prepared and their viscosity and toxicity determined immediately after solution of the drug was accomplished and at various intervals thereafter, the solutions being kept in closed glass cylinders at 37.5° C. This work required a very large number of animals and had to be confined to 11 different preparations. The results are so surprisingly consistent, however, that no reason exists which would invalidate the assumption that all arsphenamine preparations which pass the official toxicity requirement of a maximum tolerated dose (sodium salt) of 120 mg. per kilo behave in a similar way. The results obtained with these preparations were finally compiled in Table I. The first column of the table contains the relative viscosity figures. The headings of the other columns designate the lot number of the different arsphenamines, and below each lot number are given the minimum lethal doses, expressed as milligrams per kilo bodyweight. The first figure in each vertical column corresponds to the initial toxicity of the freshly prepared solution, and the lower figures to the toxicity after standing. As noted, some of the toxicity figures are those obtained after the solution had stood approximately 24 and 48 hours. The striking results are obvious, even from a cursory examination of the table.

TABLE I.—*Relation between viscosity and toxicity (M. L. D.) of various 1 per cent arsphenamine solutions (hydrochloride).*

[Viscosity determined at 37.5° C. Rate of injection 2 minutes per c. e. M. L. D. expressed as mg. per kilo.]

Relative viscosity.	M. L. D. of Lot No.—										
	1680	1824	1820	1805	Y 123	1823	1821	1812	M. D.	1806	G 73
3.081.....	4										
2.710.....	4										
2.290.....		5									
2.105.....	5		5								
2.075.....				5							
1.973.....											
1.883.....	6										
1.850.....											
1.790.....											
1.750.....	7										
1.650.....											
1.585.....											
1.570.....											
1.533.....		8		8							
1.515.....	8										
1.425.....											
1.418.....					10						
1.410.....										10	
1.370.....				10							
1.343.....						15					
1.290.....			10								
1.258.....											
1.205.....											
1.178.....											
1.168.....					15						
1.140.....											
1.123.....		15									
1.114.....			18								
1.100.....			125								
1.095.....	15					21					
1.090.....											
1.088.....							18				
1.085.....				18							
1.084.....											
1.082.....							125				18
1.078.....		25									
1.074.....											
1.065.....									25		
1.060.....								180			
1.057.....											28
1.053.....		130									
1.044.....											
1.036.....					135		142		42		28
1.034.....											45
1.026.....										32	
1.021.....									185		

¹ After solution had stood 24 hours.² After solution had stood 48 hours.

First of all it will be seen that, with very few exceptions, in the lower part of the table a certain viscosity corresponds to a certain toxicity, this relation evidently being absolutely independent of the method of preparation of the drug. The slight discrepancies are easily explained by the slight inaccuracies of the toxicity test.

It is furthermore evident that the *initial* viscosity and toxicity of freshly prepared solutions show very great variations between the different lots of the drug. For instance, Lot 1680 has an initial relative viscosity of 3.081 and an initial M. L. D. of 4 mg. per kilo, whereas Lot 1806 has an initial viscosity of 1.082 and an initial M. L. D. of 20 mg. per kilo; in other words, the higher the initial viscosity of a given preparation the greater is its toxicity.

TABLE II.—*Influence of rate of injection upon toxicity of 0.5 per cent arsphenamine solution.*

Relative viscosity.	Rate of injection.	Minimum lethal dose.
1.037-1.021.....	2 minutes per c. c.....	60 mg. S. 80 mg. S. 100 mg. S. 120 mg. SSSS. 140 mg. S. 150 mg. DDDDS.* 200 mg. DDDD. 120 mg. SDD.* 150 mg. DDDDD.
1.043-1.021.....	1 minute per c. c.....	
1.021.....	0.5 minute per c. c.....	40 mg. SSS. 60 mg. SS. 80 mg. SSD. 100 mg. S. 120 mg. DDD.*

(c) *Effect of change in rate of injection upon toxicity.*—It was of interest to determine the influence of a change in the rate of injection upon the toxicity of arsphenamine solutions of approximately the same viscosity. Table II illustrates a typical experiment of this kind. Evidently the rate of injection has some influence upon the toxicity of a 0.5 per cent solution of arsphenamine hydrochloride, but this influence is not very great. For an injection rate of 2 minutes per cubic centimeter, the M. L. D. was 150 mg. per kilo; for a rate of 1 minute per cubic centimeter it was 120 mg. per kilo; and for a rate of 0.5 minute per cubic centimeter, 120 mg. per kilo. It would appear, then, that a fast rate of injection produces a slightly higher toxicity when rather dilute (0.5 per cent) solutions of the hydrochloride are used. Incidentally we call attention to the fact that this acid solution of low viscosity is tolerated in doses which correspond to the official requirement for the maximum tolerated dose of solutions of the sodium salt of arsphenamine. The data given in Table I, on the other hand, show that a solution of the hydrochloride with high viscosity (Lot 1680) may be 37 times more toxic (M. L. D. 4 mg. per kilo).

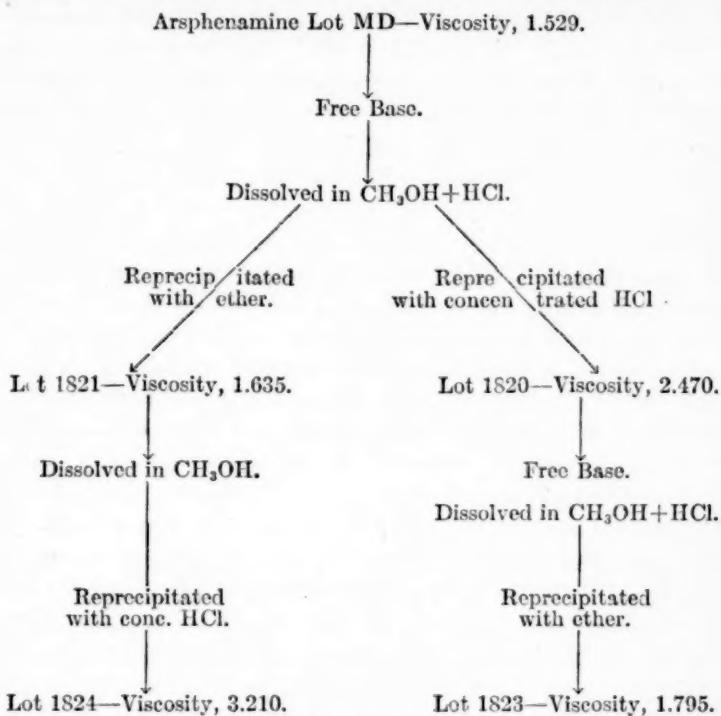
From the practical standpoint of the clinical use of arsphenamine these observations are rather significant. It has sometimes happened that, by mistake, arsphenamine has been injected as the hydrochloride instead of the sodium salt. Severe acute reactions and even deaths have been attributed to this error. The data so far mentioned in this paper furnish good evidence why such untoward reactions should occur with the use of the hydrochloride of the drug. A freshly made 1 per cent solution of Lot 1680 kills a rat within a few minutes in a dose of 4 mg. per kilo. Assuming that the toxicity in the rat and in man is of about the same order, 0.24 gram would be the fatal dose for a patient weighing 60 kilos. This dose is considerably below the maximum therapeutic dose, and hence it is not at all surprising that deplorable toxic reactions should

be observed when arsphenamine is injected in the form of the hydrochloride instead of the sodium salt.

(d) *Cause of difference in viscosity of different arsphenamine preparations.*—Our extensive experience in the examination of arsphenamine obtained from various manufacturers has shown us that the various products exhibit marked differences in their solubility in water. Some brands are very easily soluble and yield very fluid solutions; other brands are very difficultly soluble and often require heating and yield viscous solutions. It appeared quite possible that this difference in solubility might be caused by differences in the method of final precipitation of the drug. The hydrochloride can be obtained in two ways: (1) By precipitation of a methyl alcoholic solution of the drug with ether, or (2) by precipitation of an aqueous solution with fairly concentrated hydrochloric acid. The first method is the one described in the original directions of Ehrlich and Bertheim and the second was used by Kober (1921) and Christiansen (1920). Kober and Christiansen call attention to the difficulty met with in dissolving their products, whereas the old German product always was easily soluble. It should be particularly emphasized that Kober used the hydrosulphite reduction and Christiansen the hypophosphorous acid method. Yet, both obtained products of low solubility with the final hydrochloric acid precipitation, a fact which indicates that the method of reduction is not the factor which controls the physical properties of the product. In order to determine the influence of the method of final precipitation upon the viscosity of the product, the experiment illustrated by Table III was carried out.

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TABLE III.—*Influence of method of precipitation of arsphenamine on initial relative viscosity of a 1 per cent solution of the resulting preparations.*



Fifty grams of arsphenamine, Lot MD, were dissolved in 1,500 c. c. of water; 120 c. c. of 1.5 N NaOH were then added to precipitate the free base. This was filtered off on a Büchner funnel (filtrate was clear and colorless). The precipitate was washed with water and packed down. The moist precipitate was mixed with methyl alcohol and filtered again, washed with methyl alcohol, and sucked off as completely as possible. It was then mixed with 250 c. c. methyl alcohol. Then a solution of methyl alcohol containing gaseous HCl was added dropwise until all the precipitate went into solution. This solution was divided into two portions (*a* and *b*). Portion (*a*) was precipitated by pouring it into a large volume of cold (0° C.) 15 per cent hydrochloric acid, filtering off and washing with alcohol containing HCl, then ether. Before the material had thoroughly dried, it was separated roughly into two portions. One portion was allowed to dry completely in desiccator. This is Lot 1820. The other portion was dissolved in 200 c. c. water, precipitated with 75 c. c. 1.5 N NaOH, and the free base so formed was filtered off (filtrate was clear and colorless) and washed with water. The precipitate was taken out of funnel, mixed with methyl alcohol, and again filtered. It was then suspended in 75 c. c. methyl alcohol and dissolved by

the addition of methyl alcohol containing gaseous HCl. The solution was poured into 900 c. c. anhydrous ether under stirring. It was filtered off, washed with ether, and dried in desiccator; 7.1 grams were obtained. This is Lot 1823. The (b) portion mentioned above was precipitated by pouring into anhydrous ether, filtered off, and washed with anhydrous ether. It was then dried in desiccator; 20 grams were obtained. This is Lot 1821.

Ten grams of Lot 1821 were dissolved in 75 c. c. absolute methyl alcohol, then poured with stirring into 500 c. c. cold (0° C.) 15 per cent hydrochloric acid. The precipitate was filtered off, washed with alcohol containing HCl and anhydrous ether, then dried in vacuum desiccator; 9.7 grams were obtained. This is Lot 1824.

The lots precipitated by means of aqueous hydrochloric acid were without exception difficult to dissolve in water (requiring more time), and their initial relative viscosity was much higher than that of the lots precipitated by ether. (See Table III.) The viscosity figures given in Table III always refer to a freshly prepared 1 per cent solution of the hydrochloride.

This experiment was repeated with another commercial lot of arsphenamine with similar results. Moreover, five lots of arsphenamine prepared by us according to the method of Christiansen from pure oxyaminophenylarsonic acid, and which were precipitated by aqueous hydrochloric acid, also had a very high initial viscosity. Everything then points to the method of precipitation as representing the principal factor which determines the solubility, viscosity, and toxicity of arsphenamine (hydrochloride).

VISCOSITY AND TOXICITY OF ALKALINE ARSPHENAMINE SOLUTIONS.

The relative viscosity of a freshly prepared 1 per cent solution of the disodium salt is consistently lower than that of a freshly prepared 1 per cent solution of the hydrochloride. The viscosity of the former approaches that of water. Some of the data bearing upon this point are given in Table IV.

As in the case of solutions of the hydrochloride, the viscosity of the alkaline solution shows a gradual decline on standing at ordinary temperature, not, however, as great as with the former. This reduction of viscosity is accompanied by a marked reduction in the toxicity. Table V, contains by way of illustration two typical experiments. Other experiments with other lots of arsphenamine have yielded similar results. It will be noted that the initial viscosity of Lot G 73 is 1.112 at 15° C. Rats were at once injected with this solution with increasing doses as rapidly as possible, at a rate of injection of two minutes per cubic centimeter. During this time the viscosity fell gradually to 1.078. The minimum lethal dose for this range is

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100 mg. per kilo body weight. After the solution had stood for 30 minutes at 15° C. another series of rats were injected under exactly the same conditions. The data show that the toxicity had decreased about one-third, so that the minimal lethal dose was 150 mg. per kilo.

TABLE IV.—Viscosity of freshly prepared alkaline arsphenamine solutions (1 per cent.).

Lot number.	Relative viscosity of solutions of disodium salt.	Relative viscosity of solutions of hydrochloride, 1 per cent.	Lot number.	Relative viscosity of solutions of disodium salt.	Relative viscosity of solutions of hydrochloride, 1 per cent.
G 71.....	1.049	1.152	69.....	1.058	1.120
2432.....	1.065	1.195	6600.....	1.065	1.125
2357.....	1.049	1.150	6515.....	1.058	1.310
G 68.....	1.065	1.130	6587.....	1.079	1.370
73.....	1.057	1.130	122.....	1.058	1.770

TABLE V.—Influence of standing on viscosity and toxicity of a 2 per cent alkaline arsphenamine solution.

Relative viscosity.	Temperature of solution.	Rate of injection.	Toxicity.
LOT G 73.			
1.112-1.078.....	15° C.....	2 min. per c. c.....	80 mg. S, 90 mg. SD, 100 mg. SDDD,* 110 mg. DDD, 120 mg. DD, 130 mg. D.
After standing for 30 min. at 15° C.: 1.078-1.074.....	15° C.....	2 min. per c. c.....	120 mg. S, 130 mg. SS, 140 mg. SSDD, 150 mg. SDD,* 160 mg. D, 170 mg. D, 180 mg. D, 200 mg. D.

LOT MD.

1.300-1.212.....	21° C.....	2 min. per c. c.....	75 mg. D, 140 mg. SDD,* 180 mg. DDD.
After standing for 30 min. at 21° C.: 1.127-1.101.....	21° C.....	2 min. per c. c.....	180 mg. SSSS, 220 mg. SDD.*

In the case of Lot MD the viscosity of the freshly prepared solution was 1.300 at 21° C. It decreased gradually to 1.212 on standing at this temperature. The minimum lethal dose for this freshly prepared solution was 140 mg. per kilo. Further standing

reduced the viscosity from 1.127 to 1.101. For this viscosity range the minimum lethal dose is 220 mg. per kilo, i. e., almost 60 per cent higher than that of the freshly prepared solution.

A similar effect is produced by short heating of the freshly prepared solution in an atmosphere of pure hydrogen. It was thought desirable to preclude all possibility of oxidation by the elimination of oxygen and by using a low temperature for making the solution. The data in Table VI show that the viscosity of a freshly prepared 2 per cent alkaline solution of Lot 73 is 1.099 at 0° C. Rats injected with this solution under standard conditions are killed by 120 mg. per kilo. The solution was heated in a current of hydrogen for 20 minutes to 55° C., followed by rapid cooling to 0° C. This treatment reduced the viscosity to 1.061; and the minimum lethal dose is now increased to about 220 mg. per kilo.

These results then clearly show that a decrease of viscosity of a solution of the disodium salt of arsphenamine produced either by allowing the solution to stand for a short time at room temperature or by heating the solution under conditions which preclude any oxydative changes leads to a striking decrease in toxicity. The remarkable feature of these results is that considerable changes in toxicity find an expression in a relatively slight viscosity change.

TABLE VI.—*Influence of heating in a current of hydrogen on the viscosity and toxicity of a 2 per cent alkaline arsphenamine solution (G 73).*

Relative viscosity.	Temperature of solution.	Rate of injection.	Toxicity.
1.099-1.070.....	0° C.....	2 min. per c. c.....	100 mg. S. 120 mg. SDDD.* 140 mg. SDD.
After heating for 20 min. to 55° C. 1.061-1.058.....	0° C.....	2 min. per c. c.....	160 mg. S. 180 mg. S. 200 mg. S. 220 mg. D.* 240 mg. D. 260 mg. D.

Relation between viscosity of hydrochloride and toxicity of sodium salt.—We finally call attention to some experiments illustrated by Chart 3, which is intended to express the relation which apparently exists between the viscosity of various lots of arsphenamine determined on a 1 per cent solution of the hydrochloride, on the one hand, and the toxicity of the same lots as the disodium salt.

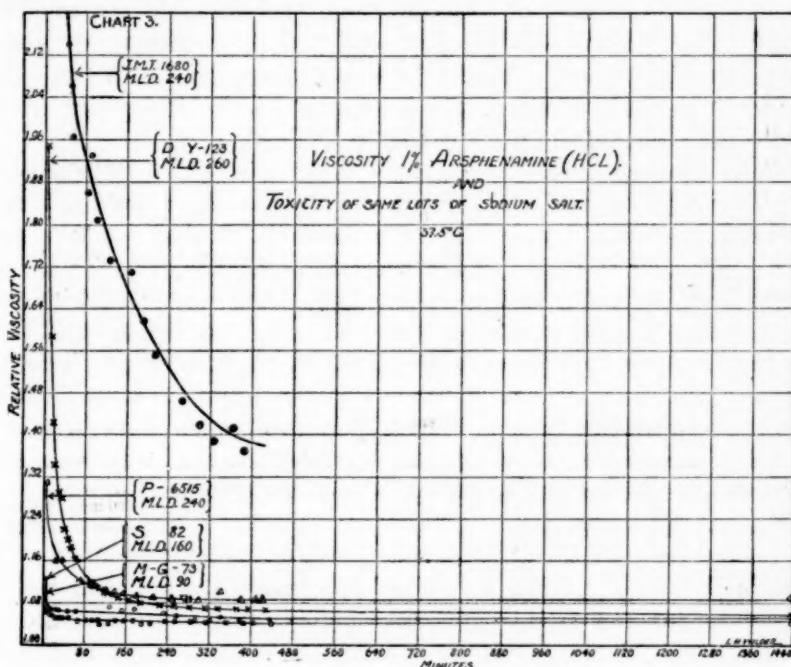
The chart gives only a few of the data. It was found quite generally that products which were difficultly soluble in water and yielded highly viscous solutions of the hydrochloride showed a very low toxicity when tested on rats in the form of the disodium salt; and, vice versa, preparations which were easily soluble in water and

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yielded less viscous solutions of the hydrochloride were found to be much more toxic when tested as the disodium salt. We do not offer any explanation of this paradox, contenting ourselves at present simply by stating the facts.

SIGNIFICANCE OF RESULTS.

The data described in this paper are of both theoretical and practical interest. They show clearly that the observations of previous workers indicating that the toxic action of arsphenamine upon the higher animals involves a physicochemical factor are correct, as it



is possible to correlate in a quantitative manner a physical property of the drug, i. e., its viscosity, with the degree of toxicity. It was proved that under conditions which preclude any oxidative change in the drug, profound physicochemical alterations may take place, and that this change is accompanied by a parallel change in toxicity. The elucidation of the nature of these changes in the drug solution *in vitro* and of those in the toxicity remains to be settled by further investigation. It is very likely that the decrease in toxicity accompanying the decrease in viscosity is essentially due to dispersion of the particles of the solution, thereby reducing the power of such solutions to enter into reactions with the colloidal constituents of the blood. We want to emphasize in this place again that arsphena-

mine behaves like an amphoteric colloid, such as proteins. Its acid and basic properties are revealed by the formation of easily soluble salts with acids and strong alkalies. In the neighborhood of the hydrogen ion concentration of the blood, the neutral "base" is thrown out of solution as a gelatinous precipitate. A pH of 7.2 might therefore be considered as the approximate isoelectric point of arsphenamine. The hydrochloride can be precipitated (salted out) by an excess of concentrated hydrochloric acid. Starting with the insoluble "base," the I_w , we can gradually convert the drug into ionized acid or basic salts by the addition of alkalies or acids, and this is obviously followed by a partial dispersion of the colloid. The known properties of arsphenamine, therefore, do not conflict with the view expressed above, namely, that the reduction in viscosity and toxicity may primarily be due to dispersion. In this connection it would be of interest to determine the viscosity of arsphenamine over a range from pH 3 to pH 10.

As far as we are aware, this work is the first in which the quantitative changes in viscosity occurring in a drug solution have so satisfactorily expressed similar changes in toxicity. It may not be amiss to suggest that viscosity measurements, which are so easily made, might be very useful in the study of problems connected with the toxic action of substances of a more or less colloidal character, such as those responsible for the so-called anaphylactoid reactions of Hanzlik and Karsner, and perhaps also the action of toxins. It is certainly surprising to find in the literature so few data in which viscosity has been made use of for biological research, whereas many papers deal with surface tension and osmotic pressure.³

From a practical standpoint, the work indicates that the toxicity of arsphenamine is subject to very great changes according to the manner in which the drug is handled before injection. It shows that if, by mistake, a freshly prepared highly viscous preparation of arsphenamine hydrochloride is injected, severe reactions and even death may be the result. After the solution has stood for some time, the chance of the production of toxic reactions is much reduced, both with the acid and alkaline solution. Finally, these results emphasize again that for purposes of accurate biological standardization of this drug, the conditions for preparing the solutions previous to injection must be absolutely uniform, otherwise the results are not reliable. As the viscosity of the alkaline solution adjusts itself in the course of about 30 minutes, and as this is accompanied by a similar adjustment of the toxicity, it is plain that this precaution, which has recently been observed in the official toxicity control of arsphenamine, rests on a scientific basis.

³ The last two properties of arsphenamine were studied by us without enabling us to correlate differences in toxicity with differences in either osmotic pressure (freezing-point method) or surface tension.

CONCLUSIONS.

This investigation indicates that there is a close parallelism between the viscosity and toxicity of arsphenamine solutions and, hence, proves conclusively that, besides the chemical factor (arsenoxide formation), there is a physicochemical factor which determines the toxicity of the drug.

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SOME OBSERVATIONS ON THE DISPERSAL OF ADULT ANOPHELES.

By M. A. BARBER, Special Expert, and T. B. HAYNE, Technical Assistant, United States Public Health Service.

The observations here reported were made during the summers of 1920 and 1922 in a rice-growing region near Stuttgart, Ark., where the great number of *Anopheles*, especially of *A. quadrimaculatus*, gave abundant material for investigation.

Several closely related questions were considered.

1. NIGHTLY DISPERSAL OF ANOPHELES FROM DAYTIME RESTING PLACES.

Roubaud¹ could recover none of a large number of *A. maculipennis* which had been stained in a barn six days previously. He is of the opinion that the anopheline population of a resting place is rapidly renewed. It seemed worth while to repeat these observations with different species of *Anopheles* and under varying conditions.

¹ Roubaud, E.: Ann. d. l'Inst. Past. XXXIV, 1920, p. 181.

In the vicinity of Stuttgart the chief daytime resting places of *Anopheles* were barns, especially those in which animals were housed during the night. Enormous numbers also congregated in privies, hollow stumps and trees, under bridges, and in the other usual resting places of these mosquitoes. Many hundreds could be regularly found under the mummified skin of a dead horse in a wood.

A protocol of one experiment will illustrate the method and results:

Experiment No. 3.—Place: A small barn in which horses were housed during the night. August 24, 1920, an estimated number of 4,000 *Anopheles* were found resting beneath the roof and eaves. Stained with an aqueous solution of eosin sprayed by means of an atomizer. As a control, 98 mosquitoes were caught immediately after the staining and tested for stain with a solvent composed of alcohol, 3 parts; glycerine, 3 parts; chloroform, 1 part. Sixty per cent proved to be stained, so it was estimated that fully 2,400 *anophelines* had been stained in the barn. On subsequent days, batches of mosquitoes, taken at random, were caught in the barn and in neighboring places and tested for stain with the solvent. Results are given in Tables I and II.

TABLE I.—*Test for stained mosquitoes recovered in the barn where stain was used.*

Interval after date of staining (days).	Number tested (all <i>A. quadrimaculatus</i> .)			Found stained.			Per cent both sexes of number tested.	
	Female.	Male.	Total.	Number.				
				Female.	Male.	Total.		
1.....	950	80	1,030	249	28	277	26.9	
2.....	547	71	618	27	2	29	4.7	
3.....	613	40	653	4	0	4	0.6	
4.....	526	62	588	2	0	2	0.3	
6.....	1,064	92	1,156	1	0	1	0.1	

Among the 4,045 *Anopheles* caught during the five days of testing there were only 9 *A. crucians*, all female. Of these, two of the four taken on the first day after the staining were colored, and none thereafter.

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TABLE II.—*Test for stained mosquitoes recovered from the vicinity of the barn where the stain was used.*

Place.	Distance from barn in which staining was done.	Interval after date of staining (days).	Numbers tested (all <i>A. quadrimaculatus</i>).			Found stained.		
			Female.	Male.	Total.	Number.		Per cent both sexes of number tested.
						Female.	Male.	
Horse barn.....	100 feet.....	1	700	5	705	0	0	0.0
		2	214	1	215	0	0	0.0
Chicken house.....	do.....	1	347	19	366	1	0	0.3
		2	196	13	209	4	0	1.9
		3	269	6	275	0	0	0.0
		4	185	15	200	1	0	0.5
		6	256	11	267	0	0	0.0
		Privy No. 1.....	200 feet.....	324	127	451	1	0	0.2
Privy No. 2.....	1,440 feet....	1	427	130	557	2	0	0.3
		2	350	17	367	0	0	0.0
		3	543	111	654	0	0	0.0
		4	250	204	454	0	1	0.2
Negro cabin.....	500 feet.....	1	167	129	296	0	0	0.0
		2	72	10	82	1	0	1.2
		3	125	13	138	0	0	0.0
		11	94	6	100	0	0	0.0
		Hollow trees, etc., in wood.	1 to $\frac{1}{2}$ mile...	56	6	62	0	0	0.0
Hollow trees, etc., in wood.	1 to $\frac{1}{2}$ mile...	1	119	132	251	0	0	0.0
		2	47	30	77	0	0	0.0
		3	63	57	120	0	0	0.0

Only 11 *A. crucians* were found in the course of the tests made of localities in the vicinity of the barn where staining was done. None was stained.

It is interesting to note the varying proportion of males found in the different localities covered in experiment 3, a proportion which, in that region, at least, was usually in inverse ratio to the number of blood-engorged females. The barn in which the staining was done contained 8.5 per cent males among the *Anopheles* caught for testing; the horse barn, 0.7 per cent; the chicken house, 4.8 per cent; privy No. 1, near the barns, 18.9 per cent; privy No. 2 in a wood near rice fields, but distant from a house or pasture, 44.4 per cent; negro cabin, 9.2 per cent; wood, in this case the most distant locality from any breeding place, 48.8 per cent. The high proportion of males, and with it a high proportion of empty females, was clearly associated with the distance from a source of blood, not the distance from a breeding place.

About 96 per cent of the females found in the "stained" barn contained blood or ova, and practically all of the stained mosquitoes recovered in the course of experiment 3 were blood-engorged or gravid females.

The weather during experiment 3 was cool, but tended to grow warmer toward the end of the experiment. Mornings were mostly foggy, and the humidity was high at night. There was very little wind.

Experiment No. 4.—September 15, 1920: Privy No. 2, described in connection with experiment No. 3, housed a large number of *Anopheles* and was selected for experiment. Since the time of the August experiment, cattle had been introduced into a pasture adjoining this privy, but the privy itself was rarely used and contained no source of blood. The proportion of males was now 37.3 per cent, and 72 per cent of the females were blood engorged. Practically all were *A. quadrimaculatus*. Methylene blue stain, aqueous solution, was used in order to avoid confusion with the previous experiment in which eosin was used. A batch of 139, collected 6 hours after staining, were tested with the solvent, and 99 per cent proved to be stained. Estimated number stained, 2,500. Results are given in Table III.

TABLE III.—*Test for stained mosquitoes recovered in the privy where the stain was used.*

Interval after date of staining (days).	Number tested (all <i>A. quadrimaculatus</i>).	Per cent found stained of number tested.
1	140	35.7
2	264	9.1
3	337	3.0
4	360	6.7
5	315	1.3
6	337	0.0

Mosquitoes from localities in the vicinity of the privy were tested. Large sample catches were taken daily from a barn 1,500 feet from the privy. About 1 per day, or 0.2 to 0.3 per cent of the number examined, was found blue colored during the first four days after the staining. None was found afterwards. A barn 1,440 feet distant in the opposite direction gave almost exactly the same proportion stained and on the same days. Four other localities, 1,340 to 2,500 feet from the privy, gave no positives. Practically all mosquitoes tested were *A. quadrimaculatus*.

On the day of staining, observations were made at this privy of the flight of mosquitoes at dawn and dusk. At earliest dawn, mosquitoes began flying into the privy and their entrance continued for about 40 minutes. They began flying out at dusk, and their exit continued during about 25 minutes, after which time but a small proportion (about one-fourth) of the number present during the day remained.

Two other experiments, one in the same privy as that of experiment No. 4 and one in a barn, gave very similar results.

Experiment No. 5.—On September 22, 1923, a somewhat different experiment was undertaken. *Anopheles* in a large series of buildings in a certain area were stained with eosin, and those in hollow trees, stumps, and the like, in a neighboring wood, with methylene blue. The staining in each locality was repeated during two or three days

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in order to stain as many as possible. The experiment was begun at the approach of cooler weather and just before a period of rapid diminution of *Anopheles* as the result of draining the rice fields. At different dates, extending from September 25 to October 20, *Anopheles* were caught in the places where they had been stained and in neighboring resting places and were tested for stain. Owing to the rapid diminution of *Anopheles*, the numbers caught on the later dates were small, but the proportion tested was larger than tested in midsummer when anophelines were very abundant. Comparatively few stained specimens were recovered, and none was found later than four days after the last application of stain. The distribution of stained mosquitoes found showed that mosquitoes had flown from barns to woods and from woods to barns, but no evidence was obtained of a tendency to seek woods as cooler weather approached, and the total numbers diminished rapidly in the woods as elsewhere.

Two red-stained *Anopheles*, including a female with blood or ova, had flown to a wood where there was neither water nor blood supply. The nearest "red-stained" locality, a large barn, was 1,770 feet away. A negro cabin, unscreened and occupied, gave 11 red-stained specimens out of a total of only 114 examined on the day following the last staining. The nearest "red-stained locality," a barn about 500 feet away, gave, on the same date, a smaller proportion of red-stained specimens than did the cabin in which no stain had been used. In previous experiments the percentage recovered in a stained locality had always exceeded that found in the neighborhood.

There was a light frost on the night of September 30, but no other frost occurred until October 27. All stained specimens were found on or before September 29.

A few more staining experiments of this nature were made during the summer of 1922 in the same region. A batch tested the day after staining showed 3.4 per cent stained; one three days after, 1.4 per cent. The summer of that year was hot and dry.

All experiments agree in indicating an early dispersal of *A. quadrimaculatus* from daytime resting places. Never over 40 per cent were recovered in a resting place one day after staining, and practically none six days after. Dispersal was practically as rapid and complete from a barn containing a nightly blood supply as from a privy where no blood could be obtained. The distribution of stained specimens recovered in certain experiments would indicate that stimuli other than the requirements of blood, oviposition, and fertilization had directed the flight of females. Possibly flock movements or meteorological stimuli were concerned as well.

It is improbable that the mosquitoes were injured by the aqueous stain used, judging by the longevity of controls stained and kept in cages. Certain experiments in which no stain was used also indicated a large daily "turnover" in the mosquito population of a resting place. *Anopheles* were destroyed or removed from such places, and on the succeeding day the numbers were as large as ever.

2. LONGEVITY OF ANOPHELES IN RESTING PLACES WHEN THE NOCTURNAL FLIGHT IS PREVENTED.

Nicholls² confined *A. albimanus* in a large room where fruit was furnished as food and an opportunity was given the mosquitoes to take human blood nearly every other day. The last were alive on the thirty-first day, none surviving the thirty-fourth. Roubaud³ confined *A. maculipennis* in a large space with domestic animals. One or two at most survived at the end of 12 days.

In some preliminary experiments we liberated about 250 *Anopheles*, practically all *A. quadrimaculatus*, in a dark closet and supplied them with water but with no source of blood. Only one or two survivors were found three days later. A batch of mosquitoes, including both *A. quadrimaculatus* and *A. crucians*, were confined in a large sleeping net hung in a dark room. Water was supplied and a fowl kept under the net. Seven days later no survivors were found. Numerous dead mosquitoes were found on the floor.

A more complete experiment was carried out, the details of which follow:

A chicken house, the floor dimensions of which were about 10 by 12 feet, partly shaded, and near rice fields, was found to be a preferred daytime resting place for *Anopheles*. From 1,000 to 2,000 of them were found congregated under the roof of the house on three visits prior to the day of the experiment. This number was probably a conservative estimate, since over 2,000 were caught there and counted in the course of some staining experiments made at a later date when numbers had apparently not materially diminished. No mosquitoes were introduced at any time.

August 22, 1922: While mosquitoes were in the house the door and window were screened and all cracks stopped with cotton. A pig weighing about 25 pounds was placed in the house, and the door was tightly closed. The number of mosquitoes in the house rapidly decreased from day to day, and on August 28, six days later, only two survivors could be found. Dead mosquitoes were found on a white cloth stretched over a bench in the chicken house.

² Nicholls, L.: Bull. Entomol. Res., III, 1912, p. 251.

³ Roubaud, E.: Ann. de l'Inst. Pasteur, XXXIV, 1920, p. 181.

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August 28: Door was opened. August 29 (morning): *Anopheles* had reentered the house; 1,100 were counted. All openings were again securely closed with screen or cotton. On September 4 only two survivors were found. Some large holes were then made in the screens, imitating a poorly screened house. September 5: Only 17 *Anopheles* had entered during the night. The door was opened widely that evening. September 6: The usual number of *Anopheles*, 1,000 to 2,000, were present.

The pig was kept in the chicken house during the entire time of the experiment. A shower fell on the first day, and the weather was relatively cool until August 28; thereafter it was hot and dry. Practically all the *Anopheles* were *A. quadrimaculatus*.

These experiments indicate that *A. quadrimaculatus* trapped in a large inclosure suffer a very high mortality even when confined in a house which they have chosen for a resting place and when supplied with abundant opportunities of obtaining blood. It is known, of course, that mosquitoes may be kept in cages for periods of time much longer than is necessary for the maturing of sporozoites; but in these cages they are protected from natural enemies and afforded a proper degree of moisture. It is the experience of most of us who have undertaken a long series of infection experiments that, even when all care is taken to keep *Anopheles* alive in cages, a disappointingly small proportion of the females exposed to the carrier survive 12 days or more.

3. LONGEVITY OF ANOPHELES UNDER NATURAL CONDITIONS.

Le Prince and Orenstein,⁴ in their experiments in Panama, recovered stained *Anopheles* 12 to 14 days after the last staining. The longest period of time elapsing between staining and recovery of *Anopheles* in our experience was 25 days. Two female *A. quadrimaculatus*, both with blood and ova, survivors of a lot stained August 24, were found September 18 in a barn in which no stain had been used. The eosin color which they showed on testing was distinct and unmistakable. The barn in which they were found was 4,200 feet from the nearest "red-stained" locality. It is possible that the mosquitoes came from an earlier experiment in which comparatively few mosquitoes were stained. In that case the distance traveled would be only 2,500 feet, but the time of survival would then be 31 days. A female *A. quadrimaculatus* was found stained in a barn in which eosin had been used 24 days previously (experiment No. 3, Aug. 24). It was the only one found red stained among 2,564 *Anopheles* caught in that barn and tested during the period Septem-

⁴ Le Prince, J. A., and Orenstein, A. J.: Mosquito Control in Panama. G. P. Putnam's Sons, New York and London, 1916, p. 113.

ber 16–21 in the course of an experiment in which methylene blue was used.

It will be remembered that no survivors were found four days after staining in the autumn experiment described (experiment No. 5), which was undertaken in part to determine longevity in cooler weather and with a much diminished anopheline production.

During August and September, 1922, a more extensive experiment was undertaken in the hope of obtaining further data on longevity under natural conditions. An estimated number of over 60,000 *Anopheles* were stained. Those of one part of the region about Stuttgart, Ark., were stained with eosin, and those of another part with methylene blue, aqueous solutions. The stain was repeated in many localities in order to stain as many as possible. In estimating numbers stained, allowance is made for those stained twice. A sample taken immediately after staining in one locality gave 100 per cent stained; in another locality, a lot caught six hours after staining gave 89.3 per cent stained.

On September 8, 19 days after the last application of stain, we began making collections and testing with a solvent for stain; these collections were continued until September 13. In all, over 15,000 were caught and tested. Not one was found stained. About 64 per cent were collected in places where stain had been used, the remainder from places in their immediate neighborhood. The weather was hot and dry during the greater part of the time covered by this experiment. During the 1920 experiments there was more rain and a greater average humidity.

4. DISPERSAL OF ANOPHELES FROM AN EXTENSIVE BREEDING PLACE.

A number of surveys were made in the town of Stuttgart, a place of about 5,000 inhabitants, in order to determine the extent to which *A. quadrimaculatus* bred in rice fields penetrated into the town. Our observations served little more than to confirm the well-known fact that numbers rapidly diminish toward the center of a town. Where thousands could be found in barns at the edge of the town, only dozens could be found in similar places at the center. The total number found well within the town, however, was large enough to make one wonder why so many of them were willing to leave a plentiful supply of blood and breeding places at the farms and penetrate half a mile into a well-screened town, where there were comparatively few domestic animals to attract them.

Further data regarding the spread of *Anopheles* from rice fields were obtained in 1922, when dry weather had reduced mosquito breeding to a very small amount in a region adjoining the rice fields. We made a survey in that region, mostly through a wooded country

opened by a railway along which were scattered houses and farms. A search was made for *Anopheles* under bridges and in barns and other buildings. Numbers tended to diminish gradually as one went farther from the rice fields, but hundreds were found in a barn about 1 mile from the nearest irrigated field. Beyond that point numbers were very small. Other observations tended to confirm the conclusion that during that summer, at least, *Anopheles* in effective numbers had spread about a mile from rice fields over a relatively open country.

DISCUSSION OF RESULTS IN RELATION TO SCREENING.

Our results indicate that *A. quadrimaculatus*, even in the case of females engorged with blood, do not under natural conditions remain long in a resting place; further, that they soon die when confined in such resting places, even when supplied with a source of blood. So far as limited numbers indicate, the same conclusions hold true with *A. crucians*. So it would seem probable that any females so securely entrapped that escape is impossible are likely to die within a few days; and that, however less desirable poor or badly tended screens are than good ones, they are not likely to serve over any long period of time as dangerous traps for infected mosquitoes.

In the vicinity of Stuttgart, Ark., the number of *Anopheles quadrimaculatus* is enormous, but the malaria rate is comparatively low. Screening, although poor in many houses, is almost universal and may be one important factor in the prevention of malaria there.

These results, however, are not to be construed as in any degree minimizing the desirability of securing the most perfect screening against mosquitoes which it is practicable to secure. They indicate, in effect, merely that it would be better not to tear out imperfect screening which, at the time, it would be impracticable to replace by better.

SUMMARY.

1. Nocturnal dispersion of *A. quadrimaculatus* from a resting place is nearly complete by the end of six days.
2. When confined in such a resting place, mortality is very high; in our experiments nearly all were dead within six days.
3. Longevity in midsummer and under natural conditions may be at least 25 days, but the proportion which could be recovered three days after staining was very small.
4. *Anopheles* in effective numbers spread about a mile from rice fields into an open country.

Acknowledgment.—Through the courtesy of Mr. H. W. Van Hovenberg, sanitary engineer of the St. Louis & Southwestern Railway Co., Mr. H. H. Stage, entomologist of that company, was detailed to Stuttgart and gave us material assistance during a part of this work.

RECORD OF PLAGUE INFECTION IN CALIFORNIA.

The accompanying table, giving a record of plague infection in California, is taken from a report recently received from Senior Surgeon J. C. Perry, Director, Public Health District No. 7, and is published here merely as a matter of historical interest.

This record shows that the last case of human plague in California occurred August 18, 1923, and the last case of squirrel plague on June 6, 1923. Intensive measures, including inspection and poisoning operations, are being carried on against the ground squirrel (*Citellus beecheyi*) in several counties of the San Francisco Bay district.

Record of plague infection.

Place.	Date of last case of human plague.	Date of last case of rat plague.	Date of last case of squirrel plague.	Total number rodents found infected since May, 1907.
City:				
San Francisco.....	Aug. 18, 1923	Oct. 23, 1908	May 21, 1917	398 rats, 1 squirrel.
Oakland.....	Sept. 10, 1919	Dec. 1, 1908	Sept. 4, 1919	126 rats, 3 squirrels.
Berkeley.....	Aug. 28, 1907	None.....	None.....	None.
Los Angeles.....	Aug. 11, 1908	do.....	Aug. 21, 1908	1 squirrel.
Santa Cruz.....	None.....	do.....	May 5, 1920	2 squirrels.
County:				
Alameda (exclusive of Oakland and Berkeley).	June 29, 1922	Oct. 17, 1909, wood rat.	July 8, 1922	466 squirrels, 1 wood rat, 3 plague-like squirrels.
Contra Costa.....	July 13, 1915	None.....	June 6, 1923	1,752 squirrels.
Fresno.....	None.....	do.....	Oct. 27, 1911	1 squirrel.
Merced.....	do.....	do.....	May 15, 1920	8 squirrels.
Monterey.....	do.....	do.....	June 16, 1920	41 squirrels, 1 plague-like squirrel.
San Benito.....	June 8, 1921	do.....	May 26, 1921	102 squirrels, 1 plague-like squirrel.
Santa Clara.....	Aug. 31, 1910	do.....	June 20, 1920	44 squirrels.
San Joaquin.....	Sept. 18, 1911	do.....	May 17, 1920	22 squirrels.
San Luis Obispo.....	None.....	do.....	Jan. 29, 1910	1 squirrel.
Santa Cruz.....	July 18, 1922	do.....	Sept. 27, 1922	40 squirrels.
Stanislaus.....	None.....	do.....	June 18, 1920	15 squirrels.
San Mateo.....	do.....	do.....	June 23, 1920	22 squirrels.

THE VILLAGE OF "HEALTHVILLE."

At the recent Virginia Educational Conference held in Richmond, there was an interesting exhibit called "Healthville," built by the Westhaven Junior Community League of Norfolk County and exhibited under the auspices of the Cooperative Education Association of Virginia. The village consisted of several small communities ingeniously built and arranged along a miniature railroad. The stations had such significant names as Bathtub Village, Orange Valley, Spinach Greens, Height-Weight Village, East Toothbrush, and Bookland. Long Sleep Mountain (windows open), the highest peak in Healthville, was stated to be "10 hours above wake level." The construction of Healthville was one of several health-work projects employed to present to the pupils of the Westhaven schools some fundamental health rules and secure the formation of good health habits by enlisting their interest and imagination.

DEATHS DURING WEEK ENDED JANUARY 19, 1924.

Summary of information received by telegraph from industrial insurance companies for week ended January 19, 1924, and corresponding week of 1923. (From the Weekly Health Index, January 22, 1924, issued by the Bureau of the Census, Department of Commerce.)

	Week ended Jan. 19, 1924.	Corresponding week, 1923.
Policies in force.....	55,879,075	51,851,429
Number of death claims.....	12,312	11,168
Death claims per 1,000 policies in force, annual rate.....	11.5	11.2

Deaths from all causes in certain large cities of the United States during the week ended January 19, 1924, infant mortality, annual death rate, and comparison with corresponding week of 1923. (From the Weekly Health Index, January 22, 1924, issued by the Bureau of the Census, Department of Commerce.)

City.	Week ended Jan. 19, 1924.		Annual death rate per 1,000, corre- sponding week, 1923.	Deaths under 1 year.		Infant mortali- ty rate, week ended Jan. 19, 1924. ²
	Total deaths.	Death rate. ¹		Week ended Jan. 19, 1924.	Corre- sponding week, 1923.	
Total.....	7,655	13.2	14.8	1,012	1,055	.....
Akron.....	31	7.8	9.0	5	14	53
Albany ³	35	15.4	19.5	5	5	110
Atlanta.....	72	16.5	24.3	11	24	.....
Baltimore ³	231	15.3	17.0	32	36	93
Birmingham.....	66	17.1	16.2	12	9	.....
Boston.....	220	14.8	20.6	38	39	105
Bridgeport.....	33	12.0	16.7	3	7	47
Buffalo.....	119	11.4	14.8	15	24	64
Cambridge.....	30	14.0	17.3	10	6	173
Camden ³	44	18.2	24.8	8	4	126
Canton.....	15	7.6	.....	4	.....	84
Chicago ³	647	11.5	11.3	94	81	87
Cincinnati.....	126	16.1	21.3	7	11	44
Cleveland.....	209	11.9	12.0	37	28	97
Columbus.....	65	12.7	20.4	6	4	57
Dallas.....	41	11.4	14.9	7	8	.....
Dayton.....	39	12.0	12.6	3	8	50
Denver.....	97	18.3	17.1	13	16	.....
Des Moines.....	29	10.4	8.5	3	4	.....
Detroit.....	234	12.3	15.1	49	54	91
Duluth.....	21	10.1	10.8	2	2	43
Erie.....	25	11.3	12.5	2	2	41
Fall River ³	45	19.4	19.0	9	9	127
Flint.....	21	8.8	11.5	9	3	155
Fort Worth.....	20	7.0	7.6	3	3	.....
Grand Rapids.....	24	8.4	16.4	3	5	47
Houston.....	41	13.4	13.1	5	7	.....
Indianapolis.....	91	13.5	14.0	14	8	106
Jacksonville, Fla.....	33	16.8	18.8	2	0	.....
Jersey City.....	56	9.4	13.5	9	11	65
Kansas City, Kans.....	29	12.8	16.7	5	10	100
Kansas City, Mo.....	83	12.0	17.0	9	15	.....
Los Angeles.....	237	17.6	16.3	19	18	59
Louisville.....	61	12.3	18.0	6	11	58
Lowell.....	39	17.6	18.1	7	4	125
Lynn.....	17	8.5	15.2	3	5	76
Memphis.....	43	13.0	26.1	5	12	.....
Milwaukee.....	113	12.0	11.3	22	20	101
Minneapolis.....	103	12.9	11.2	12	10	64
Nashville ³	46	19.4	28.1	8	4	.....
New Bedford.....	41	16.1	15.6	5	6	78
New Haven.....	23	6.8	9.9	3	6	39
New Orleans.....	161	20.5	18.8	16	22	.....
New York.....	1,468	12.7	12.8	193	179	78
Bronx Borough.....	185	11.1	9.5	29	15	102
Brooklyn Borough.....	470	11.2	11.5	53	53	57
Manhattan Borough.....	653	15.1	15.7	92	93	90

¹ Annual rate per 1,000 population.

² Deaths under 1 year per 1,000 births—an annual rate based on deaths under 1 year for the week and estimated births for 1923. Cities left blank are not in the registration area for births.

³ Deaths for week ended Friday, January 18, 1924.

Deaths from all causes in certain large cities of the United States during the week ended January 19, 1924, infant mortality, annual death rate, and comparison with corresponding week of 1923. (From the Weekly Health Index, January 22, 1924, issued by the Bureau of the Census, Department of Commerce)—Continued.

City.	Week ended Jan. 19, 1924.		Annual death rate per 1,000, corresponding week, 1923.	Deaths under 1 year.		Infant mortality rate, week ended Jan. 19, 1924.
	Total deaths.	Death rate.		Week ended Jan. 19, 1924.	Corresponding week, 1923.	
New York—Continued.						
Queens Borough.....	113	10.6	8.5	12	12	66
Richmond Borough.....	47	18.8	23.3	7	6	128
Newark, N. J.....	96	11.2	13.0	18	9	84
Norfolk.....	34	10.8	12.5	6	5	109
Oakland.....	64	13.5	13.7	4	3	50
Omaha.....	41	10.3	10.5	4	8	43
Paterson.....	31	11.5	10.5	2	1	33
Philadelphia.....	562	15.0	19.2	74	78	94
Pittsburgh.....	194	16.2	20.8	27	36	92
Portland, Oreg.....	77	14.4	14.9	6	6	62
Providence.....	69	14.8	24.3	11	14	90
Richmond.....	54	15.3	15.6	6	12	71
Rochester.....	70	11.2	14.1	9	16	71
St. Louis.....	195	12.5	13.8	17	14	...
St. Paul.....	61	13.0	11.4	7	6	60
Salt Lake City ^a	37	15.0	13.6	4	1	66
San Francisco.....	163	15.5	15.3	12	12	72
Schenectady.....	19	9.9	—	4	—	113
Seattle.....	79	13.0	9.2	7	7	68
Somerville.....	25	13.0	18.5	4	3	109
Spokane.....	28	14.0	10.5	0	2	0
Springfield, Mass.....	33	11.6	11.2	3	3	51
Syracuse.....	43	11.9	15.5	8	7	89
Tacoma.....	26	13.2	8.2	2	3	46
Toledo.....	64	12.1	13.9	6	9	57
Trenton.....	39	15.7	21.7	3	3	49
Utica.....	22	10.9	21.2	1	9	22
Washington, D. C.....	142	16.9	18.1	8	12	46
Waterbury.....	14	7.3	10.6	4	2	80
Wilmington, Del.....	31	13.5	15.9	7	3	152
Worcester.....	76	20.3	13.6	9	5	108
Yonkers.....	24	11.4	12.1	3	4	66
Youngstown.....	18	7.1	11.8	3	8	43

^a Deaths for week ended Friday, January 18, 1924.

PREVALENCE OF DISEASE.

No health department, State or local, can effectively prevent or control disease without knowledge of when, where, and under what conditions cases are occurring.

UNITED STATES.

CURRENT STATE SUMMARIES.

These reports are preliminary, and the figures are subject to change when later returns are received by the State health officers.

Reports for Week Ended January 26, 1924.

ALABAMA.		Cases.	CALIFORNIA.		Cases.
Chicken pox.....		73	Cerebrospinal meningitis:		
Diphtheria.....		11	Alameda County.....		1
Influenza.....		102	Butte County.....		1
Malaria.....		16	Stockton.....		1
Measles.....		521	Diphtheria.....		311
Mumps.....		14	Influenza.....		44
Pneumonia.....		110	Jaundice (epidemic)—Los Angeles County...		1
Scarlet fever.....		14	Lethargic encephalitis:		
Smallpox.....		9	Fort Bragg.....		1
Trachoma.....		9	Los Angeles.....		1
Tuberculosis.....		25	San Francisco.....		3
Typhoid fever.....		7	Measles.....		574
Whooping cough.....		32	Poliomyelitis:		
ARIZONA.			Los Angeles.....		1
Chicken pox.....		4	Glenn County.....		1
Diphtheria.....		2	Scarlet fever.....		315
Measles.....		43	Smallpox:		
Mumps.....		4	Compton.....		20
Scarlet fever.....		9	Long Beach.....		30
Smallpox.....		6	Los Angeles.....		139
Tuberculosis.....		1	Pomona.....		12
Whooping cough.....		1	Los Angeles County.....		61
ARKANSAS.			Scattering.....		52
Chicken pox.....		43	Typhoid fever.....		5
Diphtheria.....		6	COLORADO.		
Influenza.....		193	(Exclusive of Denver.)		
Malaria.....		19	Chicken pox.....		32
Measles.....		125	Diphtheria.....		9
Mumps.....		8	Jaundice (epidemic).....		5
Paratyphoid fever.....		4	Measles.....		91
Pellagra.....		4	Mumps.....		29
Scarlet fever.....		4	Pneumonia.....		5
Smallpox.....		8	Scarlet fever.....		38
Trachoma.....		1	Septic sore throat.....		1
Tuberculosis.....		10	Smallpox.....		3
Typhoid fever.....		5	Tuberculosis.....		38
Whooping cough.....		45	Typhoid fever.....		6
			Whooping cough.....		1

CONNECTICUT.		ILLINOIS—continued.	
	Cases.		Cases.
Chicken pox.....	101	Pneumonia.....	378
Diphtheria.....	60	Poliomyelitis:	
German measles.....	2	Clark County.....	1
Influenza.....	5	Cook County.....	1
Lethargic encephalitis.....	1	Scarlet fever:	
Measles.....	107	Cook County.....	167
Mumps.....	84	Kane County.....	18
Pneumonia (lobar).....	13	Macon County.....	13
Scarlet fever.....	177	Lake County.....	9
Smallpox.....	1	Scattering.....	124
Trachoma.....	1	Smallpox.....	12
Trichinosis.....	1	Tuberculosis.....	293
Tuberculosis (all forms).....	65	Typhoid fever.....	35
Typhoid fever.....	5	Whooping cough.....	148
Whooping cough.....	40		
DELAWARE.		INDIANA.	
Chicken pox.....	11	Chicken pox.....	78
Diphtheria:		Diphtheria:	
Wilmington.....	11	Allen County.....	15
Scattering.....	2	Delaware County.....	15
Influenza.....	6	Marion County.....	20
Measles.....	1	Noble County.....	9
Pneumonia.....	5	Warren County.....	10
Scarlet fever:		Scattering.....	69
Wilmington.....	11	Influenza.....	43
Scattering.....	6	Measles.....	518
Tuberculosis.....	3	Pneumonia.....	12
Typhoid fever.....	1	Scarlet fever:	
Whooping cough.....	5	Lake County.....	11
		St. Joseph County.....	10
		Scattering.....	72
FLORIDA.		Smallpox:	
Diphtheria.....	10	Delaware County.....	50
Influenza.....	7	Grant County.....	9
Malaria.....	8	Scattering.....	32
Pneumonia.....	5	Tuberculosis.....	13
Scarlet fever.....	2	Whooping cough.....	106
Smallpox.....	10	IOWA.	
Typhoid fever.....	2	Diphtheria.....	34
		Scarlet fever.....	80
Chicken pox.....	6	Typhoid fever.....	2
Diphtheria.....	2	KANSAS.	
German measles.....	65	Chicken pox.....	118
Hookworm disease.....	1	Diphtheria.....	51
Influenza.....	5	German measles.....	5
Leprosy.....	103	Influenza.....	6
Malaria.....	2	Measles.....	397
Measles.....	18	Mumps.....	159
Mumps.....	3	Pneumonia.....	58
Pneumonia.....	1	Poliomyelitis.....	1
Scarlet fever.....	26	Scarlet fever.....	101
Pellagra.....	8	Smallpox.....	44
Smallpox.....	1	Tetanus.....	1
Tuberculosis (all forms).....	15	Trichinosis.....	1
Typhoid fever.....		Tuberculosis.....	25
Whooping cough.....		Typhoid fever.....	3
		Whooping cough.....	89
ILLINOIS.		LOUISIANA.	
Diphtheria:		Diphtheria.....	29
Cook County.....	146	Hook worm disease.....	88
Kane County.....	12	Influenza.....	66
Rock Island County.....	9	Measles.....	345
Scattering.....	58	Pneumonia.....	50
Influenza.....	24		
Lethargic encephalitis—Cook County	1		
Measles.....	498		

February 1, 1924.

LOUISIANA—continued.

	Cases.
Scarlet fever.....	6
Smallpox.....	7
Trachoma.....	29
Tuberculosis.....	31
Typhoid fever.....	9
Whooping cough.....	16

MAINE.

Cerebrospinal meningitis.....	2
Chicken pox.....	64
Conjunctivitis (infectious).....	5
Diphtheria.....	14
German measles.....	21
Influenza.....	13
Measles.....	131
Mumps.....	53
Pneumonia.....	7
Scarlet fever.....	48
Septic sore throat.....	1
Typhoid fever.....	1
Tuberculosis.....	7
Vincent's angina.....	1
Whooping cough.....	60

MARYLAND.¹

Cerebrospinal meningitis.....	1
Chicken pox.....	219
Diphtheria.....	42
German measles.....	2
Impetigo contagiosa.....	1
Influenza.....	70
Malaria.....	1
Measles.....	91
Mumps.....	6
Ophthalmia neonatorum.....	1
Paratyphoid fever.....	1
Pneumonia (all forms).....	121
Poliomyelitis.....	1
Scarlet fever.....	112
Septic sore throat.....	2
Smallpox.....	3
Tuberculosis.....	42
Typhoid fever.....	7
Whooping cough.....	50

MASSACHUSETTS.

Cerebrospinal meningitis.....	2
Chicken pox.....	379
Conjunctivitis (suppurative).....	17
Diphtheria.....	246
Dysentery.....	1
German measles.....	17
Hookworm disease.....	1
Influenza.....	12
Lethargic encephalitis.....	4
Measles.....	443
Mumps.....	265
Ophthalmia neonatorum.....	20
Pneumonia (lobar).....	103
Poliomyelitis.....	4
Scarlet fever.....	450
Septic sore throat.....	3

MASSACHUSETTS—continued.

	Cases.
Smallpox.....	2
Tetanus.....	1
Trachoma.....	1
Trichinosis.....	13
Tuberculosis (all forms).....	128
Typhoid fever.....	9
Whooping cough.....	136

MICHIGAN.

Diphtheria.....	254
Measles.....	474
Pneumonia.....	131
Scarlet fever.....	415
Smallpox.....	130
Tuberculosis.....	187
Typhoid fever.....	7
Whooping cough.....	87

MINNESOTA.

Cerebrospinal meningitis.....	1
Chicken pox.....	142
Diphtheria.....	98
Influenza.....	2
Measles.....	307
Pneumonia.....	8
Scarlet fever.....	316
Smallpox.....	45
Trachoma.....	7
Tuberculosis.....	126
Typhoid fever.....	6
Whooping cough.....	10

MISSISSIPPI.

Cerebrospinal meningitis.....	1
Diphtheria.....	10
Scarlet fever.....	2
Smallpox.....	7
Typhoid fever.....	7

MISSOURI.

(Exclusive of Cape Girardeau.)	
Cerebrospinal meningitis.....	2
Chicken pox.....	100
Diphtheria.....	216
Influenza.....	24
Measles.....	871
Mumps.....	34
Pneumonia.....	47
Scarlet fever.....	145
Septic sore throat.....	3
Smallpox.....	6
Tetanus.....	1
Trachoma.....	1
Tuberculosis.....	68
Typhoid fever.....	5
Whooping cough.....	99

MONTANA.

Diphtheria.....	1
Scarlet fever.....	31
Smallpox.....	56
Typhoid fever.....	2

¹ Week ended Friday.

NEW JERSEY.		Cases.	SOUTH DAKOTA.		Cases.
Chicken pox.....		336	Cerebrospinal meningitis.....		1
Diphtheria.....		157	Chicken pox.....		64
Influenza.....		34	Diphtheria.....		5
Measles.....		333	Influenza.....		14
Pneumonia.....		172	Measles.....		261
Poliomyelitis.....		2	Mumps.....		3
Scarlet fever.....		190	Pneumonia.....		3
Smallpox.....		18	Scarlet fever		62
Trachoma.....		1	Smallpox.....		5
Typhoid fever.....		6	Tuberculosis.....		1
Whooping cough.....		135	Whooping cough.....		11
NEW MEXICO.			TEXAS.		
Chicken pox.....		14	Anthrax.....		1
Diphtheria.....		20	Cerebrospinal meningitis.....		1
Influenza.....		3	Chicken pox.....		25
Measles.....		38	Diphtheria.....		40
Mumps.....		6	Influenza.....		25
Pneumonia.....		11	Measles.....		116
Scarlet fever.....		6	Mumps.....		12
Tuberculosis.....		15	Pneumonia.....		13
Typhoid fever.....		12	Scarlet fever.....		25
NEW YORK. (Exclusive of New York City.)			Smallpox.....		23
Cerebrospinal meningitis.....		2	Tuberculosis.....		18
Diphtheria.....		162	Typhoid fever.....		2
Influenza.....		34	Whooping cough.....		13
Lethargic encephalitis.....		3	VERMONT.		
Measles.....		901	Chicken pox.....		26
Pneumonia.....		292	Diphtheria.....		22
Scarlet fever.....		412	Measles.....		101
Smallpox.....		2	Mumps.....		26
Typhoid fever.....		34	Pneumonia.....		1
Whooping cough.....		366	Scarlet fever.....		13
NORTH CAROLINA.			Smallpox.....		2
Cerebrospinal meningitis.....		1	Typhoid fever.....		2
Chicken pox.....		265	Whooping cough.....		108
Diphtheria.....		42	VIRGINIA.		
German measles.....		7	Smallpox—Campbell County.....		1
Measles.....		1,850	WASHINGTON.		
Ophthalmia neonatorum.....		3	Chicken pox.....		85
Scarlet fever.....		51	Diphtheria:		
Septic sore throat.....		2	Pierce County.....		10
Smallpox.....		125	Scattering.....		24
Whooping cough.....		747	Measles.....		2,818
OREGON.			Mumps.....		33
Chicken pox.....		22	Pneumonia.....		1
Diphtheria:			Scarlet fever:		
Portland.....		9	King County.....		21
Scattering.....		10	Spokane.....		43
Influenza.....		3	Scattering.....		63
Lethargic encephalitis.....		11	Smallpox:		
Measles.....		413	Spokane.....		43
Mumps.....		4	Tacoma.....		10
Pneumonia.....		16	Scattering.....		18
Scarlet fever.....		18	Tuberculosis.....		15
Septic sore throat.....		2	Typhoid fever.....		3
Smallpox:			Whooping cough.....		22
Portland.....		12	WEST VIRGINIA.		
Scattering.....		10	Diphtheria.....		18
Tuberculosis.....		9	Scarlet fever.....		15
Typhoid fever.....		3	Typhoid fever.....		7
Whooping cough.....		9			

¹Deaths.

February 1, 1924.

WISCONSIN.

	Cases.
Milwaukee:	
Chicken pox.....	7
Diphtheria.....	21
Measles.....	3
Pneumonia.....	6
Scarlet fever.....	41
Tuberculosis.....	17
Whooping cough.....	50
Scattering:	
Chicken pox.....	192
Diphtheria.....	80

WISCONSIN—continued.

	Cases.
German measles.....	2
Influenza.....	29
Measles.....	284
Pneumonia.....	31
Poliomyelitis.....	1
Scarlet fever.....	327
Smallpox.....	22
Tuberculosis.....	52
Typhoid fever.....	5
Whooping cough.....	104

Reports for Week Ended January 19, 1924.

DISTRICT OF COLUMBIA.

	Cases.
Chicken pox.....	62
Diphtheria.....	11
Measles.....	4
Scarlet fever.....	36
Smallpox.....	4
Tuberculosis.....	21
Typhoid fever.....	1
Whooping cough.....	5

NEBRASKA.

	Cases.
Chicken pox.....	27
Diphtheria.....	15
Measles.....	197
Mumps.....	4
Scarlet fever.....	56

NEBRASKA—continued.

	Cases.
Smallpox.....	1
Whooping cough.....	6
NORTH DAKOTA.	
Chicken pox.....	14
Diphtheria.....	12
German measles.....	2
Measles.....	265
Mumps.....	2
Pneumonia.....	16
Scarlet fever.....	54
Smallpox.....	8
Trachoma.....	1
Tuberculosis.....	7
Whooping cough.....	7

SUMMARY OF CASES REPORTED MONTHLY BY STATES.

The following summary of monthly State reports is published weekly and covers only those States from which reports are received during the current week:

State.	Cerebrospinal meningitis.	Diphtheria.	Influenza.	Malaria.	Malaria.	Mosquitoes.	Pellagra.	Poliomyelitis.	Scarlet fever.	Smallpox.	Typhoid fever.
<i>October, 1923.</i>											
Oklahoma.....	1	104	37	2	48	1	2	94	78	214	
<i>November, 1923.</i>											
California.....	15	1,234	102	11	1,187	4	39	883	374	96	
<i>December, 1923.</i>											
Idaho.....		38			1,031			253	17	2	
Illinois.....	4	1,118	100	3	1,953		6	1,123	21	277	
Iowa.....	2	173			283			335	30	16	
Kansas.....	2	371	23		614		2	364	49	10	
Maine.....		81	7		204		1	138	2	15	
Michigan.....	15	945			1,901			1,373	422	52	
Mississippi.....		138	1,206	3,327	1,880	146	1	37	82	46	
New York.....	9	1,761	186	3	4,760		36	2,205	56	92	
North Carolina.....	3	379			4,979		2	295	413	42	
Oregon.....	1	331	3		3,123		1	102	66	11	
Pennsylvania.....	10	2,016			1,2,600	1	1	1,930	19	152	
South Carolina.....		164	45	5	690	1		16	84	7	
South Dakota.....	2	46	7		893			256	13	4	
Washington.....	2	164			5,036		3	292	249	27	
West Virginia.....		222	123		88		2	271	12	44	
Wisconsin.....	4	588	109		1,358		5	1,196	110	19	

RECIPROCAL NOTIFICATION, DECEMBER, 1923.

Cases of communicable diseases referred during December, 1923, to other State health departments by departments of health of certain States.

Referred by—	Diph-theria.	Scarlet fever.	Small-pox.	Tuber-culosi.	Typhoid fever.	Whoop-ing cough.
Connecticut.....						
Illinois.....			3	1	2	1
Massachusetts.....						
Minnesota.....				28	1	
New Jersey.....					1	
New York.....	1	2	2			

CITY REPORTS FOR WEEK ENDED JANUARY 12, 1924.

The figures given in the following table are taken from reports made by city health officers to the Public Health Service.

The cities have been selected because of their locations, the aim being to cover the country as nearly as possible by reports from representative cities. Some cities are omitted because reports are not received.

The cities included in the table have an aggregate population of about 29,600,000.

Diphtheria.—Diphtheria appears to be slightly less prevalent in the cities included in the table than it was during the corresponding week last year. The number of cases reported is nearly the same as the calculated expectancy. This is a favorable showing, as the calculated expectancy is lower than the average for the last nine years.

Influenza.—Although influenza reports are incomplete, it is evident that the disease was less prevalent during the week ended January 12, 1924, than it was at the same time in 1923.

Scarlet fever.—In cities in most sections of the country the number of cases of scarlet fever reported during the week ended January 12, 1924, was somewhat greater than the calculated expectancy, and also slightly greater than last year.

Smallpox.—Smallpox of a mild type appears to be unusually prevalent on the Pacific coast. Cities in the East North Central and the South Atlantic States report more cases of this disease than last year. Very few deaths from smallpox are reported.

Typhoid fever.—A very slight increase over last year in the number of cases of typhoid fever is accounted for by outbreaks in two cities. The number of cases of typhoid fever reported is now so small that a local outbreak stands out prominently in the figures.

February 1, 1924.

CITY REPORTS FOR WEEK ENDED JANUARY 12, 1924—Continued.

The "calculated expectancy," given for diphtheria, poliomyelitis, scarlet fever, smallpox, and typhoid fever, is the result of an attempt to ascertain from previous occurrence how many cases of the disease under consideration may be expected to occur during a certain week in the absence of epidemics. It is based on reports to the Public Health Service during the past nine years. It is in most instances the median number of cases reported in the corresponding week of the preceding years. When the reports include several epidemics, or when for other reasons the median is unsatisfactory, the epidemic periods are excluded and the calculated expectancy is the mean of the number of cases reported for the week during nonepidemic years.

If reports have not been received for the full nine years, data are used for as many years as possible, but no year earlier than 1915 is included. In obtaining the calculated expectancy, the figures are smoothed when necessary to avoid abrupt deviations from the usual trend. For some of the diseases given in the table the available data were not sufficient to make it practicable to compute the calculated expectancy.

Division, State, and city.	Chicken pox, cases reported.	Diphtheria.		Influenza.		Measles, cases reported.	Mumps, cases reported.	Pneumonia, deaths reported.	Scarlet fever.	
		Cases, calculated expectancy.	Cases reported.	Cases reported.	Deaths reported.				Cases, calculated expectancy.	Cases reported.
NEW ENGLAND.										
Maine:										
Lewiston.....	1	2	0	0	0	1	1	2	1	1
Portland.....		3	0	0	0	7	0	4	2	1
New Hampshire:										
Concord.....	0	1	0	0	0	4	0	0	1	0
Nashua.....	0	1	0	0	0	13	0	0	2	0
Vermont:										
Barre.....	5	0	0	0	1	4	0	0	0	2
Burlington.....		1	0	0	0	0	0	1	2	2
Massachusetts:										
Boston.....	111	66	57	2	3	99	24	42	53	124
Fall River.....	15	7	5	1	0	1	0	6	3	2
Springfield.....	26	4	7	1	0	28	9	5	6	13
Worcester.....	19	5	16	0	0	2	46	7	10	27
Rhode Island:										
Pawtucket.....	1	2	2	0	0	0	0	0	1	2
Providence.....	0	16	18	1	0	1	0	6	9	56
Connecticut:										
Bridgeport.....	0	9	8	1	3	0	0	0	5	5
Hartford.....		7	8	0	0	12	0	3	8	36
New Haven.....	37	8	2	0	2	3	52	7	7	19
MIDDLE ATLANTIC.										
New York:										
Buffalo.....	0	28	27	1	0	22	0	20	19	35
New York.....	315	275	214	47	15	485	132	230	172	194
Rochester.....	27	13	7	0	0	0	1	6	10	13
Syracuse.....	38	10	14	0	0	58	2	5	12	65
New Jersey:										
Camden.....		5	8	0	0	0	0	3	2	4
Newark.....	49	26	19	17	1	12	40	14	23	18
Trenton.....	3	6	22	1	1	9	0	8	3	5
Pennsylvania:										
Philadelphia.....		75	124	2	4	37	0	108	53	62
Pittsburgh.....		25	32	0	3	15	0	53	23	47
Reading.....		5	9	0	0	1	0	1	2	2
EAST NORTH CENTRAL.										
Ohio:										
Cincinnati.....	16	19	12	0	0	35	3	12	10	8
Cleveland.....	105	36	39	10	3	7	90	25	43	32
Columbus.....		6	10	0	0	2	0	6	6	9
Indiana:										
Fort Wayne.....	0	3	12	0	0	3	0	4	2	13
Indianapolis.....	0	22	7	0	2	14	119	16	15	7
South Bend.....		2	11	0	0	1	0	1	4	10
Terre Haute.....	0	2	1	0	1	2	0	4	2	2
Illinois:										
Chicago.....	252	176	136	21	7	56	91	78	170	145
Cicero.....	12	3	2	0	0	0	9	1	1	1
Springfield.....		4	3	0	1	1	0	4	2	6
Michigan:										
Detroit.....	99	83	72	1	3	87	52	36	78	82
Flint.....	30	9	16	0	0	134	12	4	10	3
Grand Rapids.....		5	1	0	0	4	0	2	6	13
Saginaw.....	10	2	2	0	0	11	16	1	2	20

CITY REPORTS FOR WEEK ENDED JANUARY 12, 1924—Continued.

Division, State, and city.	Chicken pox, cases reported.	Diphtheria.		Influenza.		Measles, cases reported.	Mumps, cases reported.	Pneumonia, deaths reported.	Scarlet fever.	
		Cases, calculated expectancy.	Cases reported.	Cases reported.	Deaths reported.				Cases, calculated expectancy.	Cases reported.
EAST NORTH CENTRAL—continued.										
Wisconsin:										
Madison.....	17	1	3	0	0	0	0	0	3	7
Milwaukee.....	96	23	19	0	0	4	0	8	37	34
Racine.....	3	2	8	0	0	2	0	1	4	32
Superior.....	1	1	3	0	0	5	0	1	2	0
WEST NORTH CENTRAL.										
Minnesota:										
Duluth.....	4	4	2	0	0	20	0	5	5	16
Minneapolis.....	94	20	33	0	0	21	0	15	24	92
St. Paul.....	16	9	0	0	0	21	...	10	14	47
Iowa:										
Des Moines.....	1	4	3	0	0	16	0	0	9	5
Sioux City.....	2	2	4	0	0	10	0	0	3	5
Waterloo.....	4	1	0	0	0	9	3	0	2	6
Missouri:										
Kansas City.....	24	14	4	3	4	111	9	11	12	13
St. Joseph.....	5	5	1	0	0	62	3	10	4	3
St. Louis.....	26	73	38	0	0	6	6	0	28	70
North Dakota:										
Fargo.....	0	0	0	0	0	0	0	0	1	0
Grand Forks.....	1	1	0	0	0	0	0	0	1	2
South Dakota:										
Sioux Falls.....	1	1	1	0	0	108	...	0	2	2
Nebraska:										
Omaha.....	13	6	4	0	0	28	...	11	7	4
Kansas:										
Topeka.....	25	3	1	0	0	25	0	1	3	0
Wichita.....	11	3	5	0	0	23	100	4	3	5
SOUTH ATLANTIC.										
Delaware:										
Wilmington.....	2	8	0	0	1	...	...	11	2	0
Maryland:										
Baltimore.....	182	37	27	26	2	29	3	39	30	54
Cumberland.....	1	0	3	0	0	0	0	0	1	1
Frederick.....	0	1	1	0	0	0	0	0	0	0
District of Columbia:										
Washington.....	50	20	18	1	0	8	0	16	20	21
Virginia:										
Lynchburg.....	11	1	0	0	0	1	1	3	0	0
Norfolk.....	0	4	4	0	0	47	0	8	1	1
Richmond.....	6	7	0	0	1	0	0	7	5	13
Roanoke.....	4	2	1	0	1	2	0	1	1	4
West Virginia:										
Charleston.....	0	2	4	0	0	0	0	0	3	1
Huntington.....	3	1	0	0	0	0	0	0	4	1
Wheeling.....	5	1	3	0	0	0	0	0	5	1
North Carolina:										
Raleigh.....	20	1	2	0	0	3	0	0	0	4
Wilmington.....	0	1	2	0	0	31	0	5	1	1
Winston-Salem	0	1	1	0	0	99	0	5	1	2
South Carolina:										
Charleston.....	0	2	0	0	0	19	0	5	1	1
Columbia.....	4	1	2	0	0	67	7	5	1	1
Greenville.....	3	1	0	0	0	17	3	2	0	1
Georgia:										
Atlanta.....	1	3	4	3	2	19	2	20	4	4
Brunswick.....	0	0	0	0	0	4	0	0	0	0
Savannah.....	0	2	2	0	0	15	0	5	1	0
Florida:										
St. Petersburg.....	0	0	0	0	0	60	0	1	0	0
Tampa.....	0	2	0	0	0	16	0	2	1	0

February 1, 1924.

CITY REPORTS FOR WEEK ENDED JANUARY 12, 1924—Continued.

Division, State, and city.	Diphtheria.		Influenza.		Measles, cases re- ported.	Mumps, cases re- ported.	Pneu- monia, deaths re- ported.	Scarlet fever.	
	Chicken pox, cases re- ported.	Cases cal- culated expectancy.	Cases re- ported.	Deaths re- ported.				Cases cal- culated expectancy.	Cases re- ported.
EAST SOUTH CENTRAL.									
Kentucky:									
Covington.....	0	2	4	1	0	0	2	1	7
Louisville.....		10	2	3	0	0	15	5	7
Tennessee:									
Memphis.....	28	7	7	0	0	62	7	3	7
Nashville.....	0	2	1	0	1	0	8	2	1
Alabama:									
Birmingham.....	2	2	5	3	2	29	9	8	5
Mobile.....	0	1	1	0	2	0	0	1	0
Montgomery.....		1	0	3	0	1	3	1	0
WEST SOUTH CENTRAL.									
Arkansas:									
Fort Smith.....	5	1	0	0		3	0	1	0
Little Rock.....	3	1	1	3		3	8	2	5
Louisiana:									
New Orleans.....	3	14	16	5	3	30	0	17	3
Shreveport.....	0		3	0	0	14	1	3	1
Oklahoma:									
Oklahoma.....	2	2	1	0	2	11	2	3	0
Texas:									
Dallas.....	8	6	11	1	1	317	16	4	5
Galveston.....	0	2	2	0	0	0	0	1	1
Houston.....	0	3	1	0	0	1		3	0
San Antonio.....	1	1	2	0	1	7	13	1	1
MOUNTAIN.									
Montana:									
Billings.....	2	1	0	1	0	138	0	0	1
Great Falls.....	13	1	1	0	0	39	0	1	4
Helena.....	0		0	0	0	0	0	1	0
Missoula.....	3	0	1	0	0	1	0	1	1
Idaho:									
Boise.....		1	0			0		1	1
Colorado:									
Denver.....	30	8	9	0	0	31	2	21	8
Pueblo.....	3	5	2		1	123	1	3	2
New Mexico:									
Albuquerque.....		1	0	0	0	8		1	1
Utah:									
Salt Lake City ..	42	3	6	0	0	126	19	5	4
Nevada:									
Reno.....	0	0	0	0	0	0	0	1	0
PACIFIC.									
Washington:									
Seattle.....	11	6	4	0		1,315	1	9	16
Spokane.....	7	3	3	0		409	0	2	7
Tacoma.....	14	2	5	0		171	4	4	1
Oregon:									
Portland.....	23	7	10	0	0	147	2	10	7
California:									
Los Angeles.....	72	25	74	20	4	27	0	25	15
Sacramento.....		2	11	0	0	3		3	3
San Francisco.....		18	74	6	1	108		17	15

CITY REPORTS FOR WEEK ENDED JANUARY 12, 1924—Continued.

Division, State, and city.	Population July 1, 1923, estimated.	Smallpox.			Typhoid fever.			Deaths, all causes.
		Cases, enlightened expectancy.		Deaths reported.	Cases reported.		Deaths reported.	
		Cases reported.	Deaths reported.	Tuberculosis, reported.	Cases reported.	Deaths reported.	Whooping cough, cases reported.	
NEW ENGLAND.								
Maine:								
Lewiston.....	33,790	0	0	0	0	0	0	17
Portland.....	73,129	0	0	6	0	0	0	25
New Hampshire:								
Concord.....	22,408	0	0	0	0	0	0	28
Nashua.....	20,234	0	0	0	0	0	0	5
Vermont:								
Barre.....	110,008	0	0	0	0	0	0	5
Burlington.....	23,613	0	2	0	1	0	0	3
Massachusetts:								
Boston.....	770,400	0	0	0	15	1	0	10
Fall River.....	120,912	0	0	0	1	1	0	28
Springfield.....	144,227	0	0	0	2	0	0	42
Worcester.....	191,927	0	0	0	2	0	1	51
Rhode Island:								
Pawtucket.....	68,799	0	0	0	2	0	0	14
Providence.....	242,378	0	0	0	2	0	0	51
Connecticut:								
Bridgeport.....	143,555	0	0	0	2	0	0	31
Hartford.....	138,036	0	0	0	3	0	0	37
New Haven.....	172,967	0	0	0	1	0	0	46
MIDDLE ATLANTIC.								
New York:								
Buffalo.....	536,718	0	0	0	14	1	0	50
New York.....	5,927,625	0	0	0	80	14	21	1,497
Rochester.....	317,867	0	0	0	3	1	0	60
Syracuse.....	184,511	0	0	0	0	1	2	36
New Jersey:								
Camden.....	124,157	0	0	0	5	0	1	28
Newark.....	438,699	0	1	0	4	1	0	106
Trenton.....	127,390	0	0	0	4	1	0	52
Pennsylvania:								
Philadelphia.....	1,922,788	0	0	0	33	5	3	564
Pittsburgh.....	613,442	0	0	0	14	3	1	186
Reading.....	110,917	0	0	0	0	0	1	25
EAST NORTH CENTRAL.								
Ohio:								
Cincinnati.....	406,312	2	1	0	10	1	1	118
Cleveland.....	888,519	2	2	0	21	2	1	196
Columbus.....	261,082	0	1	0	3	1	0	67
Indiana:								
Fort Wayne.....	93,573	2	1	0	0	0	0	16
Indianapolis.....	342,718	3	17	0	8	1	2	100
South Bend.....	76,709	0	0	0	0	0	1	13
Terre Haute.....	68,939	0	0	0	1	0	0	22
Illinois:								
Chicago.....	2,886,121	2	3	0	41	4	21	815
Cicero.....	55,968	0	0	0	3	0	0	7
Springfield.....	61,833	0	0	0	1	0	0	28
Michigan:								
Detroit.....	995,668	5	25	1	19	3	0	24
Flint.....	117,968	2	1	0	3	1	0	29
Grand Rapids.....	145,947	1	3	0	2	1	0	40
Saginaw.....	69,754	0	0	0	2	1	0	23
Wisconsin:								
Madison.....	42,519	0	0	0	0	0	1	3
Milwaukee.....	481,595	5	1	0	6	1	0	93
Racine.....	64,393	1	1	0	1	0	0	18
Superior.....	130,671	2	2	0	0	0	1	9
WEST NORTH CENTRAL.								
Minnesota:								
Duluth.....	106,289	1	11	0	1	0	0	22
Minneapolis.....	409,125	14	6	0	6	1	0	102
St. Paul.....	241,891	17	25	0	4	0	0	71

¹Population Jan. 1, 1920.²Pulmonary only.

February 1, 1924.

CITY REPORTS FOR WEEK ENDED JANUARY 12, 1924—Continued.

Division, State, and city.	Population July 1, 1923, estimated.	Smallpox.		Typhoid fever.		Deaths, all causes.
		Cases, calculated expectancy.	Cases reported.	Tuberculosis, deaths reported.	Cases, calculated expectancy.	
WEST NORTH CENTRAL—contd.						
Iowa:						
Des Moines.....	140,923	3	2	0	0	0
Sioux City.....	79,662	3	0	0	0	0
Waterloo.....	39,667	0	0	0	0	4
Missouri:						
Kansas City.....	351,819	10	0	0	15	6
St. Joseph.....	78,232	1	0	0	3	0
St. Louis.....	803,853	2	1	0	11	47
North Dakota:						
Fargo.....	24,841	1	0	0	0	0
Grand Forks.....	14,547	0	0	0	0	8
South Dakota:						
Sioux Falls.....	29,206	2	1	0	0	1
Nebraska:						
Omaha.....	204,382	5	0	0	1	51
Kansas:						
Topeka.....	52,555	1	0	0	0	2
Wichita.....	79,261	2	5	0	0	21
SOUTH ATLANTIC.						
Delaware:						
Wilmington.....	117,728	0	0	0	1	35
Maryland:						
Baltimore.....	773,580	0	0	0	27	254
Cumberland.....	32,361	0	0	0	0	11
Frederick.....	11,361	0	0	0	0	5
District of Columbia:						
Washington.....	1,437,571	0	1	1	9	135
Virginia:						
Lynchburg.....	30,277	0	0	0	0	10
Norfolk.....	159,089	0	0	0	2	7
Richmond.....	181,044	0	0	0	5	63
Roanoke.....	53,502	0	0	0	0	15
West Virginia:						
Charleston.....	45,597	0	0	0	3	0
Huntington.....	57,918	0	0	0	2	21
Wheeling.....	1,56,208	0	0	0	0	15
North Carolina:						
Raleigh.....	29,171	0	0	0	1	10
Wilmington.....	35,719	0	0	0	0	12
Winston-Salem.....	56,230	3	3	0	3	25
South Carolina:						
Charleston.....	71,245	0	0	0	2	24
Columbia.....	39,688	0	0	0	3	1
Greenville.....	25,789	0	0	0	0	6
Georgia:						
Atlanta.....	222,963	3	48	0	8	101
Brunswick.....	15,937	0	0	0	0	3
Savannah.....	89,448	0	0	0	3	45
Florida:						
St. Petersburg.....	24,403	0	0	0	0	10
Tampa.....	56,050	0	0	0	1	19
EAST SOUTH CENTRAL.						
Kentucky:						
Covington.....	57,877	0	0	0	1	13
Louisville.....	257,671	0	0	0	3	104
Tennessee:						
Memphis.....	170,067	1	0	0	0	7
Nashville.....	121,128	1	0	0	4	51
Alabama:						
Birmingham.....	195,901	0	7	0	4	54
Mobile.....	63,858	0	0	0	3	25
Montgomery.....	45,383	0	0	0	0	21

1 Population Jan. 1, 1920.

CITY REPORTS FOR WEEK ENDED JANUARY 12, 1924—Continued.

Division, State, and city.	Population July 1, 1923, estimated.	Smallpox.			Typhoid fever.			Whooping cough, cases reported.	Deaths reported.	Deaths, all causes.
		Cases, calculated expectancy.	Cases reported.	Deaths reported.	Tuberculosis deaths reported.	Cases, calculated expectancy.	Cases reported.			
WEST SOUTH CENTRAL.										
Arkansas:										
Fort Smith.....	30,635	0	0			0	0		1	
Little Rock.....	70,916	1	0			0	0		0	
Louisiana:										
New Orleans.....	404,575	4	1	0	17	4	6	0	0	155
Shreveport.....	54,590		9	0	7		0	0	0	31
Oklahoma:										
Oklahoma.....	101,150	2	0	0	2	0	2	0	0	28
Texas:										
Dallas.....	177,274	3	0	0	3	0	1	1	0	47
Galveston.....	46,877	0	0	0	2	1	1	0	0	23
Houston.....	151,970	1	0	0	3	0	0	0	0	57
San Antonio.....	184,727	0	0	0	11	0	0	0	0	66
MOUNTAIN.										
Montana:										
Billings.....	16,927	0	0	0	0	0	0	0	0	3
Great Falls.....	27,787	2	0	0	0	0	0	0	2	9
Helena.....	112,037		0	0	1		0	0	0	0
Missoula.....	112,668	0	1	0	0	0	0	0	0	8
Idaho:										
Boise.....	22,806	0	0	0	0	0	0	0	0	6
Colorado:										
Denver.....	272,031	8	0	0	7	0	0	0	6	102
Pueblo.....	43,519	0	0	0	0	0	1	0	0	8
New Mexico:										
Albuquerque.....	16,648	0	0	0	6	1	0	0	0	12
Utah:										
Salt Lake City.....	120,241	4	1	0	1	0	1	0	1	33
Nevada:										
Reno.....	12,429	0	0	0	0	0	0	0	0	3
PACIFIC.										
Washington:										
Seattle.....	1315,685	3	3			0	2		0	
Spokane.....	104,573	6	24			0	0		0	
Tacoma.....	101,731	1	2			1	0		1	
Oregon:										
Portland.....	273,621	6	8	0	2	1	0	0	2	
California:										
Los Angeles.....	666,853	2	131	0	33	2	1	0	2	274
Sacramento.....	69,950	0	0	0	1	0	0	0	0	21
San Francisco.....	539,038	0	0	0	12	1	1	0	0	167

¹ Population Jan. 1, 1920.

February 1, 1924.

CITY REPORTS FOR WEEK ENDED JANUARY 12, 1924—Continued.

FOREIGN AND INSULAR.

PLAQUE ON VESSEL.

Mombasa, British East Africa.

Under date of December 18, 1923, four cases of plague were reported removed from a plague-infected ship arrived at Mombasa, British East Africa, December 11, 1923. Two of the cases ended fatally. The name and itinerary of the vessel were not stated.

BELGIUM.

Communicable Diseases—Brussels—November, 1923.

Communicable diseases were notified at Brussels, Belgium, during the month of November, as follows:

Disease.	Cases.	Deaths.
Cerebrospinal meningitis.....	1	1
Diphtheria.....	5	.....
Measles.....	10	.....
Scarlet fever.....	19	.....
Smallpox.....	10	.....
Tuberculosis.....	28	108
Typhoid fever.....	3	1

Population, census Dec. 31, 1922, 811,693. Present officially estimated, 803,578.

BRAZIL.

Death from Leprosy—Para.

During the week ended December 16, 1923, a death from leprosy was notified at Para, Brazil.

CUBA.

Communicable diseases—Habana.

Communicable diseases have been notified at Habana, as follows:

Disease.	Jan. 1-10, 1924.		Remaining under treat- ment Jan. 10, 1924.
	New cases.	Deaths.	
Cerebrospinal meningitis.....	1	1	.....
Chicken pox.....	3	6	.....
Diphtheria.....	5	8	.....
Leprosy.....			14
Malaria.....	19	34	.....
Measles.....	4	4	.....
Scarlet fever.....			1
Typhoid fever.....	12	2	16

¹ From the interior, 28.

² From the interior, 10.

February 1, 1924.

ECUADOR.**Plague.**

During the period December 1 to 15, 1923, 11 cases of plague with 4 deaths were notified at Guayaquil, Ecuador, and 1 case at Vino del Milagro. At Jipijapa (Manabi) plague was reported present.

Plague—Infected Rats—Guayaquil.

During the period under report, out of 16,754 rats taken at Guayaquil, 57 rats were found plague infected.

ESTHONIA.**Communicable Diseases—November, 1923.**

During the month of November, 1923, communicable diseases were reported in the Republic of Estonia as follows:

Disease.	Cases.	Remarks.
Cerebrospinal meningitis.....	1	
Diphtheria.....	29	
Measles.....	10	
Scarlet fever.....	49	
Smallpox.....	32	
Tuberculosis.....	95	
Typhoid fever.....	65	Paratyphus fever, 8 cases.

GERMANY.**Paratyphus Fever—Munich.**

During the week ended December 8, 1923, 2 cases of paratyphus fever with 1 death were reported at Munich, Germany.

GUADELOUPE (WEST INDIES).**Smallpox (Reported as Alastrim).**

Information received under date of January 2, 1924, shows that smallpox (reported as alastrim) continues present in Guadeloupe. Cases of the disease were stated to be present at Moule, a town in the vicinity of Pointe à Pitre, and in the southern section of the capital, Basse-Terre.

ITALY.**Quarantine Against Malaga and Las Palmas.**

According to information dated December 19, 1923, vessels arriving at Italian ports from Malaga, Spain, and Las Palmas, Canary Islands, have been made subject to quarantine measures against plague.

JAMAICA.**Smallpox (Reported as Alastrim)—Typhoid Fever—Chicken Pox.****WEEK ENDED DECEMBER 22, 1923.¹**

During the week ended December 22, 1923, 17 cases of smallpox (reported as alastrim) were notified in the Island of Jamaica.

During the period under report, 16 cases of typhoid fever were notified at Kingston and 1 case was notified for the surrounding country.

WEEK ENDED JANUARY 5, 1924.

During the week ended January 5, 1924, 24 cases of smallpox (alastrim) were notified in the Island of Jamaica. Of these, 2 cases were notified in the parish of Kingston.

During the same period, 16 cases of typhoid fever were notified at Kingston and 3 cases in the surrounding country.

CHICKEN POX—ST. ANDREW.

During the week ended January 5, 1924, three cases of chicken pox were notified in St. Andrew, Jamaica.

PERSIA.**Mortality from Communicable Diseases—Teheran.**

During the period September 24—October 23, 1923, deaths from communicable diseases were reported at Teheran, Persia, as follows: Measles, 8; poliomyelitis, 2; smallpox, 1; tuberculosis, 39; typhoid fever, 9; typhus fever, 1.

POLAND.**Communicable Diseases—October 21—November 3, 1923.**

Communicable diseases have been notified in Poland as follows:

October 21–27, 1923.

Disease.	Cases.	Deaths.	Districts showing greatest number of deaths.
Cerebrospinal meningitis.....	11	7	Not reported.
Diphtheria.....	132	9	Posen.
Measles.....	358	5	Warsaw.
Scarlet fever.....	627	49	Tarnopol.
Smallpox.....	3	2	Krakow.
Tuberculosis.....	61	147	Warsaw.
Typhoid fever.....	517	52	Lodz.
Typhus fever.....	38	3	Lwow.
Typhus fever, recurrent.....	16	.....	Not reported.
Whooping cough.....	172	4	Stanislawow.

¹ Public Health Reports, Jan. 18, 1924, p. 133, and Jan. 25, 1924, p. 172.

February 1, 1924.

October 28-November 3, 1923.

Disease.	Cases.	Deaths.	Districts showing greatest mortality.
Cerebrospinal meningitis.....	11	6	Lodz.
Diphtheria.....	104	8	Warsaw.
Measles.....	245	8	Do.
Scarlet fever.....	600	59	Lwow.
Smallpox.....	6	—	Not reported.
Tuberculosis.....	47	135	Warsaw.
Typhoid fever.....	380	37	Lodz.
Typhus fever.....	36	8	Kielce.
Typhus fever, recurrent.....	6	—	Not reported.
Whooping cough.....	199	3	Lwow.

Population, census of Sept. 30, 1923, 27,160,163.

Dysentery—Malaria.

During the period under report, dysentery and malaria were reported in Poland as follows: Week ended October 27, 1923—*dysentery*, 197 cases, 43 deaths, district of highest mortality, Lwow; *malaria*, 21 cases. Week ended November 3, 1923—*dysentery*, 112 cases, 22 deaths, district of highest mortality, Stanislawow; *malaria*, 13 cases.

PORtUGAL.**Plague—Lisbon.**

Information has been received showing the occurrence at Lisbon, Portugal, from December 13 to 21, 1923, of seven cases of plague.

SOVIET RUSSIA.**Anthrax.**

Under date of November 11, 1923, an epidemic outbreak of anthrax, believed to have originated in Siberia, was reported as having occurred in different localities of Soviet Russia, with greatest prevalence reported in the Crimea.

Malaria.

Under date of December 22, 1923, malaria was reported widely prevalent in epidemic form in Soviet Russia, and the president of the all-Russia central executive committee had permitted the commissariat of health to convoke the second all-Russia malaria congress at Moscow on January 14, 1924.

Malaria was stated to have become a veritable scourge in the trans-Caucasus Republics during the past few years, data for 1921 and 1922, compiled by the Gruzinian people's commissariat, showing an incidence in various localities of Gruzia up to 80 per cent or more of the population. It is reported to be the most important of all the communicable diseases in Armenia, in the valley of the Araxes, cases of the disease constituting 50 per cent of all diseases. It was stated that, in the lower areas of the trans-Caucasus, over 1,000,000

persons were infected, most of whom were not receiving medical treatment; also that malaria was retarding the agricultural and industrial development of the region, decreasing the population, and reducing the efficiency of labor. In the district of Chavka practically all workers were stated to be ill with the disease.

Some drainage to prevent mosquito breeding has been done in the Batum Sea shore district, but it was said that little had been done in the trans-Caucasus. Because of the prohibitive cost, regular quinine treatment could not be carried out in Gruzia.

TURKEY.

Cholera—Plague—Constantinople.

During the week ended December 8, 1923, a death from cholera was reported at Constantinople, Turkey. During the two weeks ended December 15, 1923, five cases of plague with two deaths were reported at Constantinople.

UNION OF SOUTH AFRICA.

Further Information Relative to Typhus Fever—Durban.¹

Further information relative to the outbreak of typhus fever at Durban, Natal, Union of South Africa, reported November 23, 1923, shows the occurrence of 23 new cases during the week ended November 24, 1923, and one case during the week ended December 1, 1923.

CHOLERA, PLAGUE, SMALLPOX, TYPHUS FEVER, AND YELLOW FEVER.

The reports contained in the following tables must not be considered as complete or final as regards either the lists of countries included or the figures for the particular countries for which reports are given.

Reports Received During Week Ended February 1, 1924.^a

CHOLERA.

Place.	Date.	Cases.	Deaths.	Remarks.
China: Hongkong.....	Nov. 18-24.....	1		
India.....				Nov. 11-17, 1923: Cases, 1,401; deaths, 847.
Turkey: Madras.....	Dec. 9-15.....	3	2	
Constantinople.....	Dec. 2-8.....		1	

PLAQUE.

British East Africa: Kenya— Mombasa.....	Dec. 9-15.....	4	2	Removed from ship arrived at Mombasa, Dec. 11, 1923.
Tanganyika.....	Nov. 4-24.....	5		
Ceylon: Colombo.....	Nov. 25-Dec. 8....	10	6	Plague-infected rats, five (5). Found, Nov. 25-Dec. 1, 1923.

¹ Public Health Reports, Jan. 11, 1924, p. 82, and Jan. 18, 1924, p. 134.

^a From medical officers of the Public Health Service, American consuls, and other sources.

February 1, 1924.

CHOLERA, PLAGUE, SMALLPOX, TYPHUS FEVER, AND YELLOW FEVER—Continued.
Report Received During Week Ended February 1, 1924—Continued.
PLAQUE—Continued.

Place.	Date.	Cases.	Deaths.	Remarks.
Ecuador:				
Guayaquil.....	Dec. 1-15.....	11	4	Rats taken, 16,754; found infected, 57.
Jipijapa.....	do.....	1		Present.
Vino del Milagro.....	do.....			
India:				
Bombay.....	Dec. 2-8.....	1	1	
Karachi.....	Dec. 9-22.....	8	6	
Madras Presidency.....	Dec. 9-15.....	237	138	
Rangoon.....	Dec. 2-8.....	1	1	
Portugal:				
Lisbon.....	Dec. 13-21.....	7		
Syria:				
Beirut.....	Dec. 1-10.....	1		
Turkey:				
Constantinople.....	Dec. 2-15.....	5	2	
On vessel:				
Ship —.....	Dec. 11.....	4	2	At Mombasa, British East Africa.

SMALLPOX.

Brazil:				
Pernambuco.....	Nov. 25-Dec. 1.....	1	1	
Belgium:				
Brussels.....	Nov. 1-30.....	10		
British East Africa:				
Tanganyika.....	Oct. 21-27.....	6		
China:				
Amoy.....	Dec. 2-8.....			Present.
Chungking.....	Dec. 2-15.....			Present.
Foochow.....	Dec. 9-15.....			Present.
Hongkong.....	Nov. 18-Dec. 8.....	322	257	
Manchuria:				
Harbin.....	Nov. 26-Dec. 9.....	8		
Nanking.....	Dec. 2-15.....			Present.
Estonia:				
Guadeloupe (West Indies).....				Nov. 1-30, 1923: Cases, 32.
India:				
Bombay.....	Dec. 2-8.....	10	4	Jan. 2, 1924: Present.
Madras.....	Dec. 9-15.....	2		Nov. 11-17, 1923: Cases, 1,020;
Rangoon.....	Dec. 2-8.....	2	1	deaths, 253.
Indo-China:				
City—				
Saigon.....	Nov. 18-Dec. 1.....	23	15	Including 100 sq. km. of surrounding country.
Jamaica.....				Dec. 16-22, 1923: Cases, 17 (reported as alastrim). For week ended Dec. 29, 1923, see Public Health Reports, Jan. 25, 1924.
Do.....				Dec. 30, 1923-Jan. 5, 1924: Cases 24. (Reported as alastrim.)
Kingston.....	Dec. 30-Jan. 5.....	2		
Java:				
East Java—				
Soerabaya.....	Nov. 4-10.....	70	10	
West Java—				
Batavia.....	Nov. 17-23.....	32	4	
Mexico:				
Manzanillo.....	Dec. 4-10.....	5	1	
Mexico City.....	Dec. 9-22.....	19		
Persia:				
Teheran.....	Jan. 6-13.....		1	
Poland.....	Sept. 24-Oct. 23.....		1	Oct. 21-Nov. 3, 1923: Cases, 9; deaths, 2.
Portugal:				
Oporto.....	Dec. 16-29.....	13	9	
Siam:				
Bangkok.....	Nov. 25-Dec. 1.....			Epidemic.
Spain:				
Valencia.....	Dec. 23-29.....	33	2	
Switzerland:				
Berne.....	Dec. 16-22.....	3		
Syria:				
Damascus.....	Dec. 9-15.....	3		
Turkey:				
Constantinople.....	Dec. 2-8.....	1		

CHOLERA, PLAGUE, SMALLPOX, TYPHUS FEVER, AND YELLOW FEVER—Continued.
Reports Received During Week Ended February 1, 1924—Continued.
SMALLPOX—Continued.

Place.	Date.	Cases.	Deaths.	Remarks.
Union of South Africa:				
Cape Province.....	Nov. 18-24.....			Outbreaks.
Orange Free State.....	do.....			Do.
Transvaal.....	Nov. 18-Dec. 1.....			Do.
On vessels:				
S. S. Torres.....	Jan. 14.....	1		At New Orleans quarantine station from Tampico, Mexico, via ports. Case in seaman signed on at Galveston, Tex., on outward voyage.
S. S. Vasari.....	Dec. 31.....	1		At Trinidad, West Indies, from Buenos Aires, Argentina. Vessel left Buenos Aires Dec. 15, 1923, for New York, via Santos, Rio de Janeiro, Trinidad, Barbados.

TYPHUS FEVER.

Bulgaria:				
Sofia.....				Dec. 2-15, 1923: Paratyphus fever, cases four (4).
Egypt:				
Cairo.....	Oct. 8-14.....	24	1	
Esthonia:				Nov. 1-30, 1923: Paratyphus fever, 8 cases.
Mexico:				
Mexico City.....	Dec. 9-22.....	31		Including municipalities in Federal district.
Persia:				
Teheran.....	Sept. 24-Oct. 23.....		1	
Poland:				Oct. 21-Nov. 3, 1923: Cases, 74; deaths, 11. Recurrent typhus: Cases 22.
Union of South Africa:				Outbreaks.
Cape Province.....	Nov. 25-Dec. 1.....			
Natal—				
Durban.....	Nov. 18-Dec. 1.....	24		Week ended Nov. 24, 1923, 23 cases; week ended Dec. 1, 1923, 1 case.
Transvaal.....	do.....			Outbreaks.

Reports Received from December 29, 1923, to January 25, 1924.¹
CHOLERA.

Place.	Date.	Cases.	Deaths.	Remarks.
India:				
Calcutta.....	Nov. 11-Dec. 8....	41	27	Oct. 14-Nov. 10, 1923: Cases, 3,343; deaths, 2,217.
Madras.....	Nov. 25-Dec. 8....	6	1	
Rangoon.....	Nov. 11-Dec. 1....	2	2	
Siam:				
Bangkok.....	Nov. 18-24.....	2		

PLAQUE.

Place.	Date.	Cases.	Deaths.	Remarks.
Azores:				
St. Michael Island.....	Oct. 20-Nov. 10...	9	5	At localities 3 to 9 miles from port of Ponta Delgada.
Bolivia:				
La Paz.....	Oct. 1-31.....		3	
Brazil:				
Bahia.....	Nov. 11-17.....	1	1	Nov. 25-Dec. 8, 1923: Cases, 2; deaths, 1.

¹ From medical officers of the Public Health Service, American consuls and other sources.

February 1, 1924.

CHOLERA, PLAGUE, SMALLPOX, TYPHUS FEVER, AND YELLOW FEVER—Continued.**Reports Received from December 29, 1923, to January 25, 1924—Continued.****PLAGUE—Continued.**

Place.	Date.	Cases.	Deaths.	Remarks.
British East Africa:				
Kenya—				
Mombasa.....	Oct. 14-20.....	1	1	Infected rats, 2.
Nairobi.....	Nov. 1-21.....	40	.....	In rural districts, several hundred. To Oct. 20, 1923: Cases, 34; deaths, 25.
Tanganyika.....				
Uganda.....	Aug. 1-Oct. 31.....	734	719	
Canary Islands:				
Las Palmas.....	Oct. 15-Nov. 15.....	14	14	
San Juan de la Rambla.....	Dec. 11.....	1	.....	Locality 52 km. from Teneriffe.
Ceylon:				
Colombo.....	Nov. 11-24.....	4	3	Plague rodents, 11.
Ecuador:				
Guayaquil.....	Nov. 16-30.....	4	2	Rats taken: 18,316; found infected, 37.
Jipijapa.....	do.....	.....	.....	Present.
Egypt:				
City—				
Alexandria.....	Jan. 1-Dec. 13.....	65	33	Jan. 1-Dec. 13, 1923: Cases, 1,479; deaths, 708.
Cairo.....	do.....	1	1	Date of last case, Nov. 29, 1923.
Port Said.....	do.....	51	29	Date of last case, Mar. 17, 1923.
Suez.....	do.....	42	23	Date of last case, Sept. 10, 1923.
Hawaii:				
Pearl Harbor.....				Dec. 14, 1923: One plague rat.
India:				
Bombay.....	Oct. 28-Nov. 17.....	2	2	Oct. 14-Nov. 10, 1923: Cases, 11,672; deaths, 7,293.
Karachi.....	Nov. 11-Dec. 8.....	33	27	
Madras Presidency.....	Nov. 4-Dec. 8.....	1,026	636	Presidency.
Rangoon.....	Nov. 4-24.....	8	4	
Indo-China:				
Saigon.....	Oct. 28-Nov. 17.....	18	6	Including 100 square kilometers in surrounding country.
Iraq:				
Bagdad.....	Nov. 11-17.....	1	.....
Java:				
Province—				
Djokjakarta.....	Oct. 1-31.....	56	.....
Kedoe.....	do.....	232	.....
Pekalongan.....	do.....	25	.....
Samarang.....	do.....	218	.....
Serabaya.....	do.....	3	.....
Soerakarta.....	do.....	318	.....
Madagascar:				
Tananaive Province.....	Oct. 1-15.....	32	28	Bubonic, pneumonic, septicemic
Tananaive Town.....	do.....	22	22	Oct. 16-29, 1923: Deaths, 11; European, 2.
Peru:				
Locality—				
Canete.....	Nov. 1-30.....	1	1	Nov. 1-30, 1923: Cases, 23; deaths, 18.
Chepen.....	do.....	1	.....
Chiclayo.....	do.....	1	1	
Lima (city).....	do.....	15	12	
Lima (country).....	do.....	4	4	
Lurin.....	do.....	1	.....
Portuguese West Africa:				
Angola—				
Loanda.....	Oct. 8-28.....	.....	12	
Siam:				
Bangkok.....	Nov. 4-17.....	2	2	
Spain:				
Malaga.....	Dec. 17.....	2	.....
Straits Settlements:				
Singapore.....	Nov. 11-24.....	2	2	
Syria:				
Beirut.....	Nov. 1-30.....	2	.....
Turkey:				
Constantinople.....	Dec. 9-15.....	1	1	

CHOLERA, PLAGUE, SMALLPOX, TYPHUS FEVER, AND YELLOW FEVER—Continued.
Reports Received from December 29, 1923, to January 25, 1924—Continued.
SMALLPOX

Place.	Date.	Cases.	Deaths.	Remarks.
Algeria:				
Algiers.....	Nov. 1-30.....	1.....		
Bolivia:				
La Paz.....	Oct. 1-Nov. 30.....	20.....	10.....	
Brazil:				
Pernambuco.....	Nov. 4-24.....	14.....	2.....	
Rio de Janeiro.....	Nov. 18-24.....	3.....	1.....	
Sao Paulo.....	Sept. 3-9.....	1.....		
British East Africa:				
Tanganyika Territory.....	Sept. 30-Oct. 20.....	8.....	1.....	
Uganda.....	Sept. 1-30.....	6.....	1.....	
Zanzibar.....	Sept. 1-Oct. 31.....	116.....	18.....	Sept. 1-30, 1923: In areas 27 miles from town of Zanzibar. Oct. 1-31, 1923: In vicinity, 1 case, 1 death. In Mkokotoni district, 39 cases, 14 deaths reported.
Canada:				
British Columbia—				
Vancouver.....	Dec. 2-22.....	7.....		
Manitoba—				
Winnipeg.....	Nov. 25-Dec. 29.....	21.....	3.....	
New Brunswick—				
Madawaska County.....	Dec. 8-15.....	1.....		
Ontario—				
Fort William and Port Arthur.....	Dec. 16-29.....	3.....		Occurring at Fort William.
Quebec—				
Montreal.....	Nov. 30-Jan. 5.....	1.....		
Saskatchewan—				
Regina.....	Dec. 9-15.....	1.....		
Ceylon:				
Colombo.....	Nov. 11-17.....	1.....		Port case.
Chile:				
Concepcion.....	Oct. 1-31.....		7.....	
Talcahuano.....	Nov. 26-Dec. 2.....	3.....		Nov. 12-Dec. 3, 1923: Deaths, 5.
Valparaiso.....	Dec. 9-15.....		1.....	
China:				
Amoy.....	Nov. 18-Dec. 1.....			Present.
Chungking.....	Nov. 4-24.....			Present and endemic.
Foochow.....	Nov. 4-Dec. 8.....			Present.
Hongkong.....	Oct. 28-Nov. 17.....	137.....	169.....	
Manchuria—				
Harbin.....	Nov. 12-25.....	5.....		
Shanghai.....	Dec. 29.....			Prevalent.
Chosen: (Korea)				
Seoul.....	Nov. 1-30.....	1.....		
Colombia:				
Buenaventura.....	Nov. 18-Dec. 15.....	8.....		
Ecuador:				
Esmeraldas.....	Nov. 16-30.....	4.....		
Egypt:				
Port Said.....	Nov. 24-Dec. 2.....	1.....		
Greece:				
Saloniki.....	Oct. 22-Nov. 4.....		7.....	
Guadeloupe (West Indies):				
Basse Terre.....	Dec. 18.....			Present.
Marie Galante.....	.....do.....			Off shore island; present.
Pointe à Pitre.....	.....do.....			Present in vicinity.
India:				
Bombay.....	Oct. 28-Dec. 1.....	28.....	12.....	Oct. 14-Nov. 10, 1923: Cases, 2,655; deaths, 543.
Madras.....	Nov. 4-Dec. 8.....	6.....	2.....	
Rangoon.....	Nov. 4-Dec. 1.....	7.....	3.....	
Indo-China:				
City—				
Saigon.....	Nov. 4-17.....	27.....	9.....	Including 100 square kilometers of surrounding country.
Iraq:				
Bagdad.....	Oct. 24-Nov. 17.....	11.....	8.....	
Jamaica:				
Kingston.....	Nov. 25-Dec. 29.....	3.....		Nov. 25-Dec. 29, 1923: Cases, 98. Report for week ended Dec. 22, 1923, not yet received.
Java:				
East Java—				
Soerabaya.....	Oct. 28-Nov. 3.....	110.....	14.....	
West Java—				
Batavia.....	Oct. 27-Nov. 16.....	11.....	5.....	

February 1, 1924.

CHOLERA, PLAGUE, SMALLPOX, TYPHUS FEVER, AND YELLOW FEVER—Continued.**Reports Received from December 29, 1923, to January 25, 1924—Continued.****SMALLPOX—Continued.**

Place.	Date.	Cases.	Deaths.	Remarks.
Latvia.....				Oct. 1-31, 1923: Cases, 3.
Mexico:				
Mexico City.....	Nov. 25-Dec. 8.....	13	.....	Including municipalities in Federal District.
Vera Cruz.....	Nov. 3-Dec. 30.....	.....	4	Oct. 7-20, 1923: Cases, 8.
Poland.....				
Portugal:				
Lisbon.....	Nov. 11-Dec. 22.....	19	8	
Oporto.....	Nov. 25-Dec. 15.....	26	14	
Siam:				
Bangkok.....	Oct. 28-Nov. 24.....	29	17	
Siberia:				
Dauria Station.....	Oct. 21.....	.....		Present. Locality on Chita Railway, Manchurian frontier.
Sierra Leone:				
Sherbro District— Tagbail.....	Nov. 1-15.....	3	.....
Spain:				
Barcelona.....	Nov. 15-21.....	.....	1	
Valencia.....	Nov. 25-Dec. 22.....	119	9	
Switzerland:				
Berne.....	Nov. 18-Dec. 15.....	9	.....	Corrected.
Syria:				
Aleppo.....	Nov. 25-Dec. 1.....	1	.....	In vicinity, at Djisr Choughour.
Damascus.....	Nov. 16-22.....	1	.....
Tunis:				
Tunis.....	Oct. 27-Nov. 2.....	5	1	
Turkey:				
Constantinople.....	Nov. 11-17.....	2	.....
Union of South Africa.....				Oct. 1-31, 1923: Colored, cases, 41; deaths, 2; white, cases, 3.
Cape Province.....	Oct. 28-Nov. 3.....	.....		Outbreaks.
Natal.....	do.....	.....		Do.
Orange Free State.....	do.....	.....		Do.
Transvaal— Johannesburg.....	Nov. 25-Dec. 1.....	1	.....
Uruguay:				
Montevideo.....	Oct. 1-31.....	1	.....

TYPHUS FEVER.

Algeria:				
Algiers.....	Nov. 1-30.....	3	1	
Bolivia:				
La Paz.....	Oct. 1-Nov. 30.....	18	2	
Chile:				
Antofagasta.....	Dec. 2-8.....	4	.....
Concepcion.....	Oct. 1-31.....	.....	1	Dec. 5, 1923: 3 cases under treatment.
Talcahuano.....				Dec. 24, 1923: In hospital, 34 cases.
Valparaiso.....	Nov. 25-Dec. 15.....	.....	29	
China:				
Antung.....	Nov. 12-Dec. 9....	2	.....
Chungking.....	Nov. 18-24.....	.....		Present.
Egypt:				
Alexandria.....	Nov. 19-Dec. 9....	2	.....
Cairo.....	Sept. 10-23.....	2	3	
Hungary.....				July 1-Aug. 31, 1923: Cases, 24.
Latvia.....				Oct. 1-31, 1923: Cases, 12; paratyphus fever, 7; recurrent typhus, 3.
Mexico:				
Mexico City.....	Nov. 25-Dec. 8....	40	.....	Including municipalities in Federal District.
Poland.....				Sept. 23-Oct. 20, 1923: Cases, 133; deaths, 13.
Spain:				
Barcelona.....	Nov. 29-Dec. 12.....	.....	2	
Turkey:				
Constantinople.....	Nov. 11-Dec. 15.....	13	.....

CHOLERA, PLAGUE, SMALLPOX, TYPHUS FEVER, AND YELLOW FEVER—Continued.

Reports Received from December 29, 1923, to January 25, 1924—Continued.

TYPHUS FEVER—Continued.

Place.	Date.	Cases.	Deaths.	Remarks.
Union of South Africa.....				Oct. 1-31, 1923: Colored, 287 cases, 58 deaths; white, 2 cases; total, 289 cases, 58 deaths.
Cape Province.....				Oct. 1-31, 1923: Colored, cases, 245; deaths, 47.
Do.....	Oct. 28-Nov. 17.....			Outbreaks.
Natal.....				Oct. 1-31, 1923: Colored, cases, 4; deaths, 3.
Do.....	Oct. 28-Nov. 3.....			Outbreaks.
Durban.....	Nov. 24.....	72		Cases occurring among native stevedores in the harbor area of the port and confined to one barracks.
Orange Free State.....				Oct. 1-31, 1923: Colored, cases, 25; deaths, 8.
Transvaal.....				Oct. 1-31, 1923: Colored, cases, 13.
Do.....	Oct. 28-Nov. 3.....			Outbreaks.
Johannesburg.....	Nov. 11-17.....	1		
Yugoslavia:				
Croatia—				
Zagreb.....	Dec. 2-15.....	3		
Serbia—				
Belgrade.....	Nov. 25-Dec. 1.....	1		

YELLOW FEVER.

Brazil: Pernambuco City.....	Nov. 16.....	3	2	
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